PASSENGERS, PARCELS AND PANTHERS

The Story of Our Working Aircraft

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by

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INTRODUCTION

THERE WILL BE few readers of this book who have not, at some time or other, paid their shilling to stand in the public enclosure at one of Britain's international airports, to watch great, gleaming air liners landing and taking off for the four corners of the earth. This is as it should be, for our future is in the air and the public enclosures are helping to create 'air-mindedness' among the young designers, pilots and passengers of tomorrow.

Aircraft carrying the flags of a score of foreign lands come and go all day, every day, with no more excitement or ceremony than railway trains at a busy station. It all looks very safe, luxurious and efficient—and it is!

Yet there is much that the average visitor misses. He sees some of the fifty million men, women and children who fly each year on regular airline services: but that is only part of the story of flying today. If he could see inside the freight sheds, his eyes would goggle at the vast assortment of cargoes that are carried by air—everything from beans to bullion and bulldozers.

A visit to the R.S.P.C.A. Hostel at London Airport might be even more startling, for the air travellers who receive food, shelter and medical attention there include

elephants, panthers, cobras and almost every other animal except the giraffe, whose neck was not made to go into an aeroplane!

Passengers, parcels and panthers—a queer mixture; but even stranger cargoes are often carried. This book takes readers behind the scenes at airports, military airfields, factories and everywhere that aeroplanes fly, throughout the world; to give, for the first time in any book, a complete picture of the work being done by aviation today—work which is affecting the lives of every one of us more and more and which, in time, may bring peace and prosperity to the whole world, as a prelude to the greatest adventure of all time—flight through space to the Moon and planets.

Chapter One

GROWING WINGS

HOW OLD IS air transport?—ten years? . . . twenty . . . thirty . . .? Say a thousand years and you would be nearer the truth, because it was around the year A.D. 990 that an ancient Vizier of Baalbek in the Middle East heard that his master, the Caliph Aziz of Cairo, wanted some fresh cherries. Being a resourceful character, he immediately sent for 600 carrier pigeons, tied to their legs small bags each containing one cherry and despatched them on the 400-mile flight to Cairo; where the Caliph was soon able to sit down to a really good feed of his favourite fruit. We can only hope that it was not preceded by pigeon pie!

Nowadays, fresh fruit by the ton is carried as a regular cargo by transport aircraft. But it is a comparatively new development, because most of the people who thought seriously about flying in the 900 years after that pioneer pigeon air freight operation in the Middle East believed aircraft to be more useful for war than for peaceful purposes.

Typical was Francesco de Lana, a Jesuit priest, who designed in 1670 an incredible 'Flying Boat', consisting of a sort of rowing boat slung under four large copper

globes. The idea was to pump all the air out of the globes, to create a vacuum inside them, so that they would become lighter than the air they displaced and 'float' on the air just as a ship floats on water.

Unfortunately, it soon became obvious that the globes could not be made both light enough to achieve buoyancy and strong enough to withstand the pressure of the air outside them—so de Lana announced very tactfully that he had decided not to continue with his project 'in case the Flying Boat was used to drop fire-balls on soldiers and cities in time of war'.

All kinds of bright ideas for getting into the air were suggested in the next hundred years. None worked by itself, so another priest, this time a Brazilian named Bartholomeu Gusmao, combined the lot in a contraption which he called the 'Passarola' or swallow. Like de Lana's design it had a boat-like hull, which was intended to be lifted by feather wings, magnets, rarified air, a big parachute-sail and possibly even rockets. It was, of course, completely impractical and anything less like a graceful swallow would be difficult to imagine. So perhaps its name recorded the fact that the King of Portugal 'swallowed' Gusmao's claims for the aircraft and paid him a great deal of money to finance his experiments.

Flight was eventually made possible in 1766 when Henry Cavendish discovered that 'inflammable air' (hydrogen) was lighter than air. But nobody realized the significance of this at the time and when the first practical aircraft were built by two French brothers, Joseph and Etienne Montgolfier in 1782-83, they were hot air balloons.

Gusmao was probably first to realize that because hot

air rises it might be 'strong' enough to lift a balloon or 'air ship', for he is believed to have sent up a small hot air balloon at Lisbon in 1709. But the Montgolfiers were left to develop the idea. They started by holding paper bags over their kitchen fire at home and watching them rise to the ceiling after filling with hot air. Then they made a large linen and paper balloon, filled it with hot air from a fire lit on the market place in their home town of Annonay on 5th June, 1783, and released it successfully. Three months later, on 19th September, the first air passengers—a sheep, a duck and a cock—landed safely after a short flight in a still larger balloon.

The next stage, obviously, was to attempt the first human ascent, and the King of France suggested that a criminal from one of the state prisons might be willing to take the risk in exchange for a free pardon. But a young scientist named Pilâtre de Rozier thought it would be tragic if the honour of being first to fly went to a criminal, and volunteered to make the flight himself. So, on 21st November, 1783, de Rozier and the Marquis d'Arlandes climbed aboard a huge, gaudy Montgolfier balloon in the gardens of the Château de la Muette in Paris. A fire was lit beneath them, which soon filled out the balloon with hot air. Released, it rose quickly, and the two aeronauts flew more than five and a half miles over Paris before making a safe landing.

Hot air balloons remained in use for many years; but they were not particularly safe aircraft to fly in, because a fire had to be carried in a brazier beneath them during flight to keep them airborne, and this often set fire to the balloon fabric.

Fortunately, the far more efficient and safe hydrogen

filled balloon had meanwhile been invented by another Frenchman, Professor Charles. The first one flew without a pilot as early as 27th August, 1783, well before de Rozier's first aerial voyage. Charles had heard about the Montgolfiers' experiments, assumed wrongly that they were using hydrogen to lift their balloons, and decided to design a similar balloon himself. He did it so well that it incorporated every basic feature still found in the sporting balloons of today.

Charles himself made the first flight in a hydrogen balloon on 1st December, 1783, travelling 27 miles. But there were many people who doubted that flying would ever be more than a hazardous sport. To one of them who asked him what use a balloon was, Benjamin Franklin, the American scientist-President, replied: 'And of what use is a new-born baby?'

In fact, the 'baby' grew quickly and within two years the English Channel was flown for the first time by Blanchard and Jeffries in a hydrogen balloon. Nine years later, on 2nd June, 1794, the aircraft started work, when a French captive balloon was used for military reconnaissance at Maubeuge. It was so successful that observation balloons remained in worldwide service until machine-guns were fitted to fighter aeroplanes in the 1914-18 War, after which they were too vulnerable to be of any further use, except as unmanned barrage balloons.

Aerial reconnaissance was not, however, the only work pioneered by balloonists. The German V.1 flying bomb of 1944-45 was foreshadowed nearly 100 years earlier by the Austrians, who attacked Venice with pilotless bomb-carrying hot air balloons in 1849. And the most dramatic ballooning operation of all time was almost

certainly that organized during the siege of Paris by the Prussians in 1870-71.

Altogether 66 balloons were flown out of the city during the siege, of which 59 reached friendly territory, five fell into the hands of the enemy and two disappeared, having probably been blown out to sea. Needless to say, their passengers had many exciting adventures, especially as most of the flights were made at night to avoid the attention of the Prussian gunners.

Chief task of the balloon service was to evacuate 'VIPs' and more than 100 were flown to safety, including the famous republican leader Gambetta. In addition, nine tons of mail were lifted, and over 400 carrier pigeons, of which 57 eventually found their way back into Paris, carrying 100,000 messages on microfilm—an idea we re-invented as the Airgraph letter to save space aboard our mailplanes in World War II.

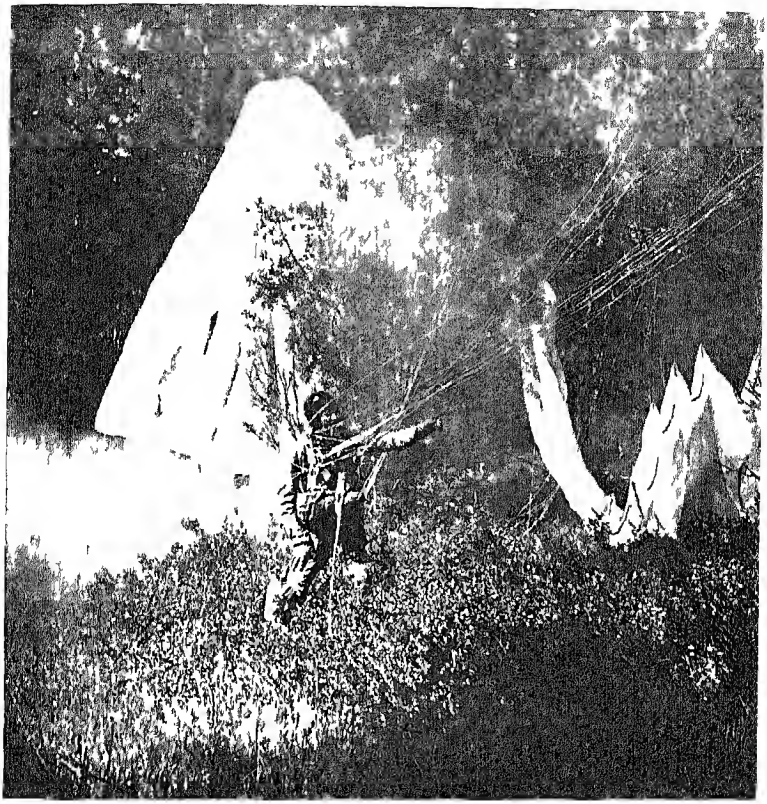
But balloons were—and are—used for peaceful work as well as war. By their use, scientists were able to study for the first time the atmosphere at great heights. As early as November, 1784, Henry Cavendish was busy analyzing samples of the upper air brought back by Dr. Jeffries after a high altitude flight with Blanchard. He found that its composition was the same as air near the earth's surface—a fact that was confirmed in 1804 by the Frenchman Gay-Lussac, who also discovered that magnetic force did not vary very much at different heights.

Even more valuable were the meteorological flights made by James Glaisher and Henry Coxwell in 1859-66, on behalf of the British Association. On six occasions they rose to more than 20,000 ft, their most famous and alarming ascent being made on 5th September, 1862,

when the balloon climbed so high that Glaisher lost consciousness and Coxwell only just managed to clamber up and open the gas release-valve in time to save their lives. They certainly could not have reached 37,000 ft, as was claimed at the time; but it was a brave and valuable flight.

The balloonists who made these ascents to further scientific knowledge risked death from asphyxiation or extreme cold every time they flew and, in 1875, two were killed during a climb to 27,950 ft. But not for another 20 years was it realized that equally good results could be obtained by using unmanned balloons, which could carry recording instruments to immense heights and, more often than not, be retrieved afterwards. Such balloons are still used all over the world by meteorologists today, although much of the data is now radioed back automatically to ground observers while the balloons are in flight; so it is not so essential to retrieve them afterwards. Some, like the American 'Skyhook', are very big indeed and drift quickly when caught in streams of fast-moving air at high altitudes. Being silver, they reflect the sun's rays and can sometimes be seen from the ground, which explains many of the popular 'flying saucer' stories.

Except for such work, and for sport, the balloon is of little value, because it can go only where the wind carries it. Lighter-than-air flying was, however, given a fresh lease of life in 1852 when a Frenchman named Henri Giffard made a cigar-shaped balloon and fitted it with a 3 h.p. steam engine, driving a propeller, so producing the first airship. In 1884, Renard and Krebs built a greatly improved airship called *La France*, which could be steered properly in flight; and by the end of the century the German Count von Zeppelin had begun production



Within seconds of dropping among the trees, a smoke-jumper of the U S Forest Fire Service prepares to remove his parachute harness and face mask and start tackling a fire Draped on trees to each side of him are the 'chutes of other members of his squad

Eskimos gather round a Dakota air ambulance of the R.C.A.F. on a mercy mission to the village of Hebron, Labrador.

Thousands of miles to the south a crowd of very different passengers board a freighter of West African Airways.

of the giant airships which became the most formidable military aircraft in the world by the start of the 1914-18 War.

The Zeppelins carried 206 of the 282 tons of bombs which dropped on Britain during that war, before they too fell victim to the incendiary bullets of British and French fighter planes. What is not so well known is that they also operated the world's first regular airline services, carrying 35,000 passengers for a total of 170,000 miles between 1910 and 1914. Later, in the 1920's and 1930's, their bigger, more streamlined descendants, the wonderful old *Graf Zeppelin* and the *Hindenberg* even ran regular passenger services across the Atlantic, long before air liners were reliable or efficient enough for such work. But they were too slow and, to a certain extent, at the mercy of the elements; and airship travel died with the *Hindenberg*, which was destroyed in a terrifying sea of flames in 1937, with great loss of life.

So, we are left with the fixed-wing aeroplane and the rotating-wing helicopter to perform the thousand and one jobs that make up the complex pattern of aviation today. Both are descended from the feather-and-wax flapping wings of Daedalus and Icarus, the model glider built by Sir George Cayley in 1804, Stringfellow's first steam-driven model aeroplane of 1848, and the lovely bird-like gliders with which Lilienthal made more than 2,000 flights between 1891 and 1896. These men were among the most important pioneers of flight; but greatest of all were two American bicycle makers named Orville and Wilbur Wright who, on 17th December, 1903, made the first controlled and sustained flight in a powered aeroplane at Kitty Hawk, North Carolina.

It was not much of a flight by modern standards—just 120 ft—less than the wing span of a Constellation air liner. And the fragile stick-and-string Wright biplane was a 'dead-end' design, almost useless for anything but sporting or demonstration flights. But the Wright brothers proved to a disbelieving world that flight in a heavier-than-air craft was possible, and their success was an inspiration to other men, who built better, more efficient aeroplanes. From their achievements have grown, in the words of Col. Charles Lindbergh, 'wings to lift a world'.

Chapter Two

WINGS OF WAR

'WHAT A DREAM it was; what a nightmare it has become,' commented Orville Wright sadly as he watched the aeroplane grow into a deadly weapon of war and destruction. But it is silly to wish that the aeroplane had never been invented just because it has been misused. If we do, we might equally regret that motor cars were invented, because they paved the way for tanks and armoured cars—or let the thought of battleships and submarines spoil a happy afternoon on the river in a row-boat!

Much more significant is the fact that the aeroplane would never have grown so rapidly into a vehicle able to make life more enjoyable for all of us had it not also been useful for war. The first aeroplane to fly in Britain—Cody's 1908 biplane—was financed by the War Office. Geoffrey de Havilland started his career as designer at the Army's Royal Aircraft Factory, Farnborough. The first aeroplane to fly the Atlantic non-stop in 1919 was a converted Vimy bomber. The engines and sweptback wings of jet air liners like the Comet were developed originally to make fighter planes faster and more deadly. The 'sound barrier' was penetrated for the first time by a

research aeroplane built with United States Air Force cash. Indeed, the life-and-death struggle to design and build ever more powerful and efficient warplanes has set the pace of aviation progress for 40 years.

Even Orville Wright, despite his later 'nightmare', realized that flying could not progress without government support. As early as 1905, he and Wilbur were trying hard to sell their biplane to the American, British and French Armies for reconnaissance duties; and it is difficult to believe that they really thought aeroplanes 'could play a major part in preventing war because (they) would enable each side to know what the other was doing and thus make it more difficult for either to gain an advantage.'*

In any case, few of the other pioneers had any illusions on the subject. By 1910, the French Voisin brothers had fitted a machine-gun to one of their pusher biplanes. In the same year, two Bristol Boxkites took part in Army manoeuvres on Salisbury Plain, during which one of the pilots transmitted the first wireless messages from an aircraft in flight to a ground station. In 1911, the French Antoinette company built an amazing monoplane covered with armour plate to protect it from ground fire—an entirely unnecessary precaution as it was too heavy to lift itself into the air! At about the same time, in America, the first aerial bomb was dropped from a Wright biplane, by Lt Myron Crissy, who carried it on his lap until the time came to throw it overboard.

Despite these early experiments, few army and navy leaders considered aeroplanes useful for anything but

* From *Miracle at Kitty Hawk*—(Farrar, Straus and Young, New York).

reconnaissance when war broke out in 1914. Pilots and observers usually carried revolvers or rifles to take a pot-shot at any enemy aircraft they might encounter; but it was all rather gentlemanly and little damage was caused until the young Dutch designer Anthony Fokker, who was working for the Germans, invented an 'interrupter gear' that allowed a machine-gun to fire through the propeller of a fighter without chewing off the ends of the propeller blades. After that, air fighting began in earnest.

An Englishman named Snowdon Hedley is said to have dropped a bomb on the Turks during the war between Bulgaria and Turkey in 1912. But the first really successful bombing raid was made by two pilots of the Royal Naval Air Service, flying Sopwith Tabloid single-seaters in October 1914. The Tabloids were intended only for reconnaissance; but this sort of work was too tame for the adventurous young R.N.A.S. pilots then stationed at Antwerp. So they fixed a sort of pipe-rack to the sides of their aircraft in which they could carry a few small 25 lb bombs. They dropped the bombs by pulling a piece of string, which released pins holding the bombs in the rack. It was all very primitive, but Flight Lieut Marix managed to drop his bombs from 600 ft on to a Zeppelin shed at Düsseldorf, producing a most satisfactory fire which destroyed both the shed and a Zeppelin inside it!

Bombing soon became more scientific. Proper bomb-racks and bomb-sights were invented, and bombers grew rapidly in size and power. By the end of the war they had reached the stage where the newly-formed Royal Air Force was preparing to bomb Berlin non-stop from bases in England with huge four-engined Handley Page V/1500 bombers, carrying 1,650 lb bombs.

So, the 1914-18 War produced the first true fighter and bomber aircraft. It also saw the start of photographic-reconnaissance, anti-submarine patrol and other duties. But, in general, military flying in 1918 required only five distinct types of operational aircraft—the single-seat fighter, two-seat fighter, light day bomber, heavy night bomber and reconnaissance aircraft.

World War II changed all that, and the complexity of modern war, in an atomic age, demands four or five different classes of fighter aircraft alone.

In the 1914-18 War, it was an achievement to shoot down a bomber at all. Even in World War II, if the defences claimed 10 per cent of an attacking force they were doing well. Nowadays, because of the fantastic destructive power of the hydrogen bomb, every single bomber that reaches its target can cause more devastation than a 1000-bomber raid of 1944-45. So air defence forces are confronted with the impossible task of trying to shoot down *every* raider.

At present, the main screen consists of fighters like the British Hunter, American Super Sabre and F-102 delta, and Russian MIG-17; but these may be the last of the conventional single-seaters. Their place will be taken by two very different types of fighter—a comparatively light-weight, fast-climbing single-seater and a very big, complex, two-seat all-weather fighter.

The first of the lightweight fighters—the SNCASO Trident—has already flown in France. Its bullet-shaped fuselage houses pilot, radio, guns, three powerful rocket motors and fuel. In addition, it carries a small jet engine at the tip of each of its stubby 'straight' wings. The idea is to take off and climb on full power, cruise on the jets

alone to save fuel, and cut in the rockets to drive it faster than the speed of sound (760 m.p.h. at sea level: 660 m.p.h. at 35,000 ft) in combat. Other combined jet-and-rocket interceptors will almost certainly follow: but availability of the tremendously powerful de Havilland Gyron jet engine may enable British designers to save weight and the need to carry two different kinds of fuel, by getting all the power they need from a single jet engine.

In an effort to achieve still higher rates of climb, and operation from small spaces, independently of long runways, a completely new type of target defence fighter is being developed. A first glimpse of these atomic age interceptors has been given by the U.S. Navy's Lockheed XFV-1 and Convair XFY-1, each of which is powered by an Allison T-40 propeller-turbine engine, driving contra-rotating propellers. But the true target defence fighters will almost certainly be powered by jet or rocket motors, which will thrust them up to 60,000 ft in about two minutes.

Designed to take off vertically, these aggressive little fighters will need no runways. On the ground, they may stand on tiny tail wheels or be carried on a launching ramp, with their noses pointing vertically upwards. Alternatively, they may have downward-pointing jet-engines, like Rolls-Royce's fantastic 'Flying Bedstead', to thrust them into the air. In action, they will not be launched until enemy bombers are reported to be approaching overhead. Then, they will streak straight up towards the bombers at a fantastic rate-of-climb, making a quick pass at the enemy with guided rocket missiles.

Being small, these target defence fighters will be unable to carry all the complex radio and radar aids needed to

hunt down and destroy high-flying bombers at night or in bad weather. They will merely be 'last ditch' defenders, intended to tackle the bombers that elude the main fighter screen.

In time, both orthodox single-seat and target defence interceptors may be replaced by pilotless rocket missiles: but it is unlikely that we shall be able to dispense with the bigger fighters. They are an inevitable result of the steadily increasing complexity and weight of fighter aircraft. The little Sopwith Pup of 1915, powered by an 80 h.p. engine, armed with a single gun and carrying no radio, weighed only 1,313 lb. The 1940 Spitfire Mk. 1 weighed 5,820 lb, but by 1945 heavier armament, more powerful engines, increased radio, radar and other equipment had raised the weight of the Spitfire Mk. 22 to 9,900 lb, and the single-seat jet fighters of today weigh twice or three times as much as that.

With so much aeroplane to fly and fight, the pilot needs some help with his navigation and radar, although much of it is automatic. Hence the need for long-range two-seaters like the R.A.F.'s Gloster Javelin and the forthcoming Avro Canada CF-105, which will weigh as much as two fully-loaded Dakota airliners.

At the moment, the Javelin, like the Hawker Hunter, is armed with four cannons able to fire 30 mm. (1.2 in.) shells at a very high rate; but in due course these will be succeeded by guided missiles, and a typical interception will then go as follows:

The enemy bomber will be picked up by radar, while still well out to sea, probably flying at 600 m.p.h. at a height of 50,000 ft. The fighter will take off on a course designed to intercept the bomber well before it reaches

its target. Climbing through the night sky at anything up to 30,000 ft per minute, it will be kept on course by radio messages from G.C.I. (Ground Controlled Interception) radar stations on the ground. As soon as it gets near the enemy bomber, the fighter's radar observer will switch over to his own airborne radar, which will pick up the bomber. The pilot will have nothing more to do, for the radar will guide the fighter towards its target and, as soon as it is within range, will fire the rockets automatically with uncanny accuracy. After which the pilot will take over again and return to base.

It may sound a bit like science fiction; but it is not. In fact, the present-day U.S.A.F. F-94C Starfire and F-86D Sabre fighters use a technique little less advanced than this.

So much for defence. Fighters are also used for attack nowadays—in fact many of them, like the F-100C Super Sabre, can carry small atomic bombs, as well as rockets, high-explosive bombs and napalm jellied-petrol fire-bombs.

In the past, such fighter-bombers have usually been aircraft no longer good enough for first-line interceptor duties: but a new generation of lightweight fighters is now being produced especially for the job of providing close support for armies in the field. Stripped of all unnecessary equipment, they are smaller and lower-powered than the interceptors, but still very fast and, because of their light weight, able to take off from small fields in the battle area.

The Folland Gnat and Avro delta-wing fighter-bomber are typical of this new class of aircraft, which would be able to race in at tree-top height, fire their rockets or drop

their bombs and escape before the enemy defences were alerted. The French Baroudeur is even more advanced. It has no proper undercarriage, but takes off either with the aid of a rocket-propelled trolley or on its small landing skids, which enable it to operate from very small fields or even from sand or ice.

Finally, the Americans are developing a long-range single-seat fighter called the F-101 Voodoo, to attack distant targets and escort their heavy bombers.

The R.A.F. has no need for such an aircraft, as its new 'V' bombers—the Valiant, Victor and Vulcan—are designed to fly very fast and at very great heights, relying on their performance alone to elude enemy interceptors. Able to carry atomic bombs over very long ranges, they represent the 'new look' in bomber fleets. Costing anything up to a million pounds each and packed full of radar navigation and bombing aids, they are so formidable that we do not need many squadrons of them, even if we could afford them.

The U.S.A.F. is confronted with a different problem, as its potential targets in war are much farther away than ours are. So its eight-jet B-52 Strato fortress bomber has had to sacrifice high altitude for range and speed, which is why it needs fighter escort.

To back up the heavy bombers, large forces of light bombers are essential. At the moment, both the R.A.F. and U.S.A.F. use the British-designed Canberra, while the Russians have the IL-28, which is in the same class, able to carry about three tons of bombs at about 600 m.p.h. for long distances. But already the first pilotless atom-bombers—Martin Matadors—are in service with the U.S.A.F. and in time, when their accuracy has been

improved, they will probably take over completely from the light tactical bombers.

Other pilotless bombers—or, more correctly, guided weapons—like the Bell Rascal are designed to be dropped from ordinary heavy bombers in flight, so that they can be guided into the target without the piloted bomber having to approach the enemy defences.

Photographic-reconnaissance is more vital than ever today, and Britain, America and Russia are all producing special versions of their newest and best bombers and fighters for the job. The R.A.F., for example, will have camera-carrying Swifts for low-level, high-speed photography, Canberras for photographing more distant targets and Valiants for high-altitude, long-range reconnaissance.

But bombers, fighters and photographic-reconnaissance aircraft are only three of the classes of aircraft needed for military combined operations today. Transport aircraft are essential to carry troops and supplies, guns, tanks, lorries and equipment into battle zones. Tanker aircraft have to be available to escort and refuel in mid-air jet fighters and bombers engaged on operations beyond their normal range. Big helicopters are needed to carry troops and equipment in combat zones, over rivers and mountains, more quickly and in areas where ordinary vehicles or aircraft could not operate. Small helicopters are used for casualty evacuation, observation and liaison duties.

Light planes like the Auster observe and correct the fire of field artillery. Coastal patrol bombers still have the vital task of hunting and attacking enemy submarines and surface warships, in co-operation with naval carrier-

based aircraft. And behind the operational types are the training planes; the target-towing aircraft which give 'live' gunnery training to army and naval anti-aircraft gunners; the air-sea rescue aircraft, many of them carrying a lifeboat beneath their fuselage to parachute to 'ditched' airmen. All these, and others, make up the complex pattern of military aviation today—a 'nightmare' perhaps, but the threat of the hydrogen bomb alone makes the prospect of another world war so terrible that it may deter any nation from starting one. If it does ensure peace in this way, aviation—which delivers the bomb—will contribute more to the prosperity and happiness of the world than any other of man's inventions.

Chapter Three

FLYING FOR FUN

IT'S FUN TO fly; especially in one's own aeroplane. Unfortunately, it is also very expensive. The cheapest British light plane is the Auster Autocrat, which costs around £1,500. Add to that insurance, fuel and oil costs, hangarage, landing fees, maintenance charges, and an annual Certificate of Airworthiness check—which alone can cost anything from £50 to £120—and you have to be quite wealthy to be a private owner today.

Even if you fly other people's aircraft at flying clubs, you will still need a fair amount of cash. Dual control instruction on an Auster averages £3 an hour; solo flying only a little less. And you must put in a total of 30 or 40 hours flying to qualify for a Private Pilot's Licence.

As a result, about the only way that the average British youngster can ever hope to become a pilot is by joining the Royal Air Force or Fleet Air Arm. This is a very good thing for the safety of our country, but not so good for our future as an air-faring nation. We need a steady supply of first-class young pilots for our civil airlines, and it would be far better if they were taught to fly civil aircraft from the start, instead of spending some of their best flying years on jet fighters and bombers first.

Realizing the importance of getting young people into the air, the French Government has taken the far-sighted step of helping financially anyone who builds his own light aeroplane. This might seem a very dangerous business; but it is not, because French designers have produced a whole series of safe, practical little single and two-seat aeroplanes since the war, any of which can be built easily at home by amateurs. In fact, more than 900 sets of plans and kits of parts have been sold already, without any apparent rise in the accident rate!

Typical of these French light planes is the Bébê Jodel, a rectangular wood and canvas low-wing monoplane, the plans of which can be bought for only £10. Powered by a 26 h.p. modified Volkswagen motor car engine, it will fly for 286 miles at 81 m.p.h. and uses little more fuel and oil than a small car. It is hardly a junior Spitfire; but young Frenchmen are having a lot of fun with it, and many of them have already had the best holiday of their lives touring the Continent, and even crossing the Channel to England in their own aircraft, with less trouble than doing the same trips by car.

There is no Government subsidy to help any British youngster with the initiative to want to build his own light plane. But the Certificate of Airworthiness regulations have been relaxed a little, so that amateurs can obtain a Permit to Fly home-built aeroplanes of approved types, provided they are constructed under expert supervision. In addition, since 1st July, 1950, the Air Ministry has helped to encourage private flying by offering free tuition at local flying clubs, up to Private Pilot's Licence standard, to selected youngsters from the Air Training Corps and R.A.F. Section of the Combined Cadet Force.

Naturally, priority is given to Cadets who will later volunteer for flying duties with the Royal Air Force; but the scheme *is* encouraging air-mindedness, and is helping the private flying clubs, which were having a lean time in 1950.

Even before this scheme started, all Cadets had an opportunity of learning to fly in gliders and the A.T.C. is, in fact, the biggest gliding organization in the world, making a total of around 100,000 launches each year. The additional 'Flying Scholarship' scheme gives the keenest Cadets an even better start to their flying career.

In the first four years, 1,668 of them were awarded 'Scholarships', which are worth about £150 each and involve completion of a course of 30 hours flying within three months at a club near their home. Of the trainees, 1,151 gained their Licences; 91 more were still under instruction; and 183 waiting to start.

It is a wonderful opportunity for the lucky lads, because the instruction they get at private clubs is the best in the world, and all the facilities of the club are put at their disposal, just as if they were private members. Typical of most is the West London Aero Club at White Waltham Aerodrome, near Maidenhead, where instruction is given on Tiger Moths. The Chief Flying Instructor is a young lady who, as a wartime member of Air Transport Auxiliary, not only ferried from factory to R.A.F. Squadrons every type of warplane from Meteor jet fighters to Stirling four-engined bombers, but was qualified to teach other pilots to fly them too.

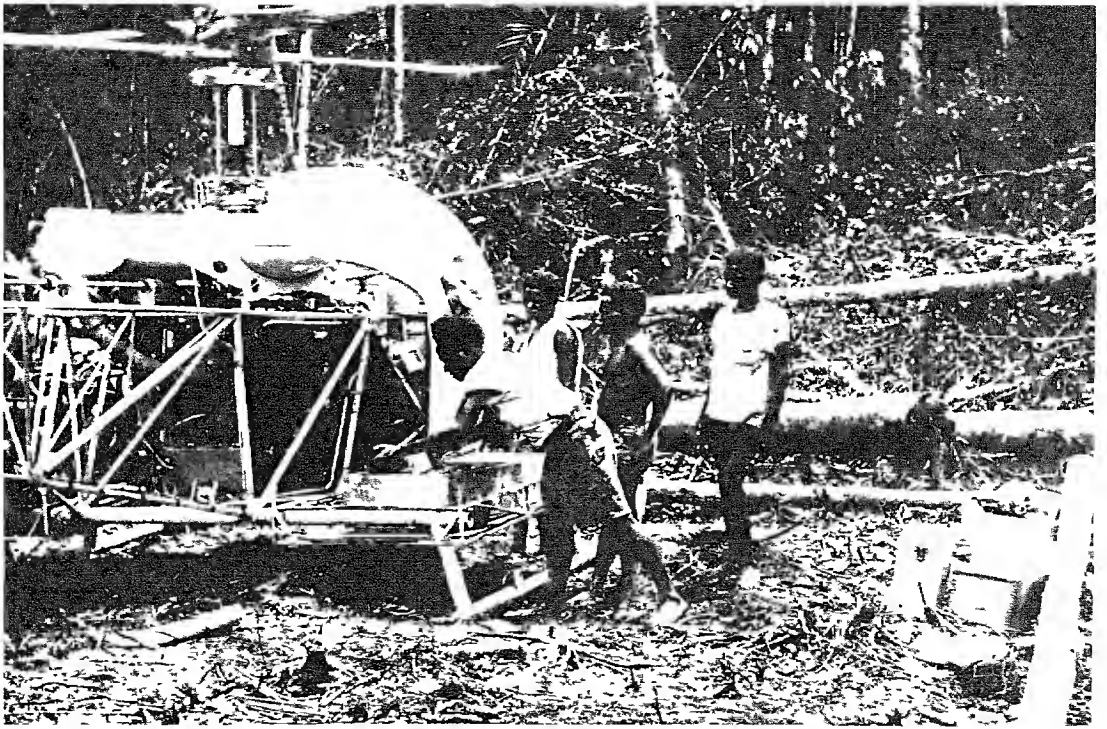
At White Waltham, on almost any day, you will find her doing 'circuits and bumps' with new pupils and watching the more experienced ones make their first solos. You

can see also a varied selection of other single and twin-engined light planes belonging to private owners. But they are a fast disappearing tribe, because, quite apart from expense, many other factors are against private flying in Britain. Distances are small, and our roads and rail services are first class; the country is criss-crossed with air-lanes, down which constant streams of air liners fly under the strict radio and radar control of ground stations; and the weather is often bad. As a result, the number of aircraft in Britain which are used for private flying, and which hold valid Certificates of Airworthiness, is less than 400, if we exclude commercial air liners.

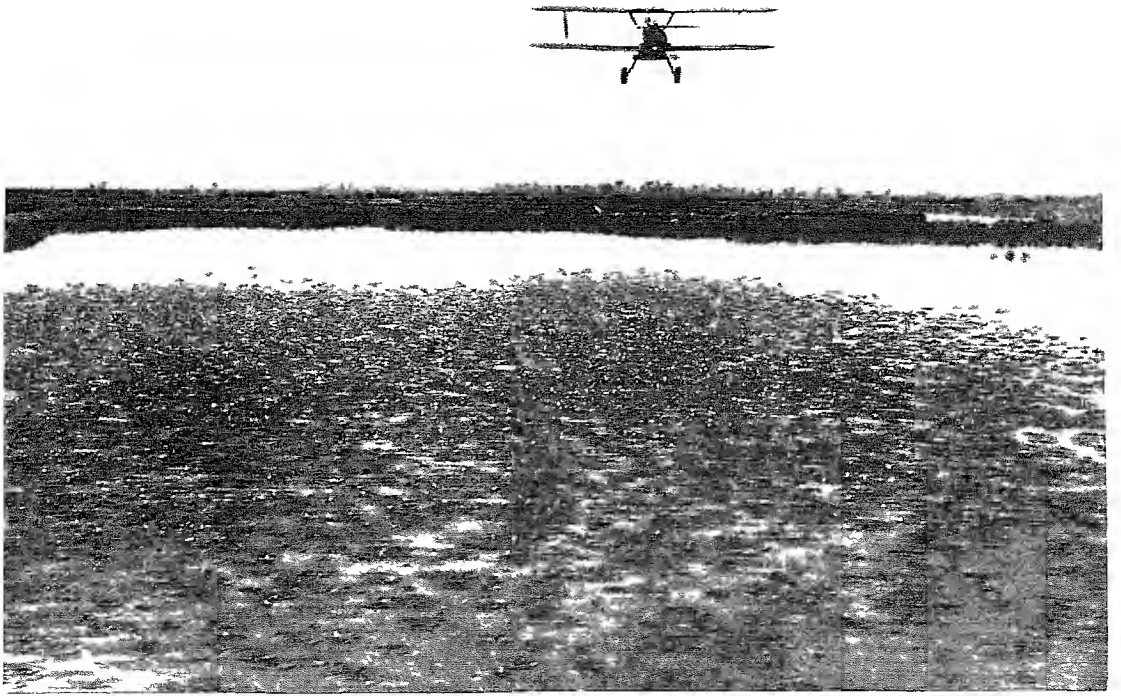
But take a look at America, where wages are high, fuel cheap, distances great and the weather good. In the State of California alone there were 10,067 civil aircraft in 1953; in Texas there were 6,581 and in Illinois nearly 5,000. In the whole of the country, 10,000 private aeroplanes were being used on business duties, and they were flying over 309 million miles a year with a safety record even better than the airlines.

Quite a lot of Americans fly for fun, and they even organize mass tours, when as many as 100 light planes fly in loose formation on holiday trips to places like Havana, the colourful capital of Cuba. No hit-or-miss affairs, every person taking part in such a flight must wear a life-jacket when flying over the sea, and the U.S. Navy or Air Force usually sends along an air-sea-rescue flying boat, just in case one of the light planes suffers an engine failure on the way.

But by far the majority of U.S. private flyers combine business with pleasure, and the little planes that carry the family on pleasure trips at the week-end are usually



Deep in the dense tropical jungles of New Guinea a Bell 47D helicopter is unloaded by native Papuans during an expedition in search of oil



Farming the new way — rice being sown from the air over fields near Sacramento California

busy earning their keep for the rest of the week. The jobs they do are incredibly varied. Thousands are used by farmers to travel around their vast ranches; to search for stray cattle; fetch supplies and machinery spares from the nearest town, which may be many miles away; and, of course, for crop spraying to destroy weeds and insect pests.

Business houses use private aircraft to fly their key men from city to city, saving precious hours compared with road, rail or even airline travel. Dealers fetch urgently needed goods from the manufacturers in their personal planes. Newspapers give their reporters and cameramen 150 m.p.h. mobility. In fact, there is hardly a business that cannot benefit from having one or two aircraft available, and some big concerns operate what is almost a private airline.

The air fleet of American business includes everything from tiny 65 h.p. Piper Cubs to 4,800 h.p. 44-seat Convairliners, and the trend is towards the larger machines. At first, business executives were quite happy to fly themselves around in Cubs; but Americans are very publicity conscious and there is little doubt that U.S. airline advertising campaigns emphasizing the speed, comfort and safety of their big multi-engined air liners began to have an effect on the businessmen.

They became discontented with the 100 m.p.h., rather cramped, single-engined Cubs, and wanted something more luxurious, with metal construction, retractable undercarriage and radio. So, after the war, there was a steady demand for aircraft like the 4-seat Beech Bonanza and Ryan Navion. Prices were up considerably compared with the Cub; but so was performance, the Bonanza's

205 h.p. Continental engine giving a top speed of 190 m.p.h. and range of 775 miles at 120 m.p.h. More than 3,500 Bonanzas and 1,000 Navions were sold, without affecting unduly sales of the lighter, cheaper, Cub type of aircraft, which continues to be bought in thousands by pilots who want an economical sporting or family plane.

But, after a time, even the Bonanzas and Navions were not good enough. Executives decided they wanted twin engines for greater safety, more baggage space, de-icing equipment, more radio aids and still higher performance —in short, they wanted junior air liners, able to compete with the airlines in speed as well as convenience.

An aircraft salesman named Jack Riley, in Florida, saw the demand coming and drew up an ingenious scheme for converting Navions into twin-engined aeroplanes, by replacing their normal 205 h.p. Continental engine with two wing-mounted 150 h.p. Lycomings, and putting a baggage compartment where the engine used to be, in the fuselage nose. No easy job, the conversion requires some 2,000 engineering drawings and 1,837 specially-made parts; but the result is a fast, safe 'twin' at a fraction of the cost of a new aircraft.

Orders for 'Twin-Navions' rolled in. Seeing the red light, Beech, Cessna and even Piper began building new 4-6 seat 'twins', and these also are selling well. But some business firms set their sights even higher, and to meet their requirements, the Airesearch Company are converting wartime B-26 Marauder day-bombers into 300 m.p.h. 14-passenger transports, powered by two 2,100 h.p. Pratt and Whitney engines and carrying every possible radio and safety aid. The cabins of these aircraft are comfortably equipped with settee, armchairs, cocktail cabinet,

telephones and beautifully appointed toilet compartment. But for sheer luxury there has never been anything quite like the Convairliner which the Temco Aircraft Corporation equipped for the Government of Saudi Arabia, and which includes a bedroom and bath, in addition to a spacious 20-passenger airline-style cabin, a buffet and an executive office complete with large desk, swivel armchairs and a deeply cushioned divan.

Even so, aircraft manufacturers are never surprised to receive unusual requests from the Middle East, since the day when they were asked to fit a swivelling throne into King Ibn Saud's personal Dakota, so that no matter which way it was flying he could always sit facing Mecca!

Of course, the cost of such specially equipped aircraft is fantastically high; and the people who own them seldom do the piloting themselves. So they do not really belong in the same class as the Bébé Jodels, or even the small business planes which are flown for fun as well as profit. But who can doubt that the example of Kings, Queens, Presidents, statesmen and other great and famous people who fly regularly about their daily business is good for aviation as a whole?

Our own Royal Family fly many thousands of miles each year in everything from helicopters to jet airliners. They have their own private aeroplanes, maintained by the Queen's Flight of the Royal Air Force and, of course, the Duke of Edinburgh is a fully-qualified pilot who flies himself all over this country and to the Continent in light transport aircraft. There could be no better assurance of the safety and convenience of air travel today.

Chapter Four

FIFTY MILLION PASSENGERS

IT IS RIGHT that young men should learn to fly, because the future of our Commonwealth—whose members are scattered all over the surface of the globe—lies in the air. But judging by the way that some motorists and motor-cyclists behave on the roads, it might be just as well for the rest of us that flying is not yet cheap enough or easy enough for *them* to be able to perform their tricks in the air above us. Quite apart from the danger of collision, an aeroplane needs far more regular, skilled maintenance than a car, because if the engine stops in flight the pilot cannot simply hop out and raise the bonnet to see why.

Anyway, is it so dull to be merely a passenger? We all travel quite happily in railway carriages without wanting to have our own private locomotive. So why should we not be content to do our flying in somebody else's aeroplane?

The airlines are doing all in their power to make us happy and contented. Fares are continually being reduced. Speed and comfort improve every year and, most important of all, so does the airline safety record. Accidents *do* still happen, of course, and they always will, because no method of transport, not even walking, can ever

be completely safe. But in one recent year, American airlines alone carried 31 million passengers a total distance of more than 18,000 million passenger-miles, with an accident record on their internal services of only 0·6 fatalities per 100 million passenger-miles.

What this means in plain straightforward language is that, on average, a passenger travelling on U.S. internal airlines would have to travel a distance equivalent to more than 6,660 times around the world before it was his turn to be killed! He would, in fact, be just about as safe as on our British railways.

To see how such a wonderful safety record has been achieved, one has only to compare a typical flight of today with one made in 1919 or 1920, when the first international airlines began to link London, Paris, Brussels and other cities, using converted bombers. There was little of the luxury of today, and it is almost impossible to convey to anyone who has experienced modern air travel what such a journey meant only 36 years ago.

In the first place, flying had a reputation for being dangerous—not without justification—and to fly was an adventure to tell the folks about for weeks afterwards. It was expensive and, with a head-wind, could be slow as well as unreliable. And, of course, it was exceedingly uncomfortable. The two or three passengers, bunched up in woollies and leather coats, sat facing each other on wicker seats in a space so small that there was no room to stand or move. In fact about the only thing a passenger could do in such draughty, noisy, bumpy surroundings was to think 'this is marvellous, I hope!' Little wonder that one leading booking agent in London refused to recommend to his customers the indignities of air travel.

Passengers from London took off from Croydon Airport, which consisted of a rather bumpy meadow with a few sheds in one corner, where passengers could wait if the weather was too bad for flying or if the engine refused to start. It was approached by a narrow winding track called Plough Lane and, with typically carefree 'planning', the aircraft hangars were on the opposite side of this lane to the aerodrome itself. Consequently, passengers who arrived when an air liner was crossing the lane were stopped by the only aircraft level-crossing gates in the world.

Radio was seldom carried in those days, and the only safety aid normally provided at the Airport was a windsock to indicate direction of the wind. When an air liner was seen approaching, a look-out on the wooden tower identified it with a pair of binoculars and announced its arrival. He then gave the signal for a klaxon to be sounded, which alerted H.M. Customs officers and ground staff. Passengers' baggage was handled by anyone from the manager downwards, and valuables were kept for safety under his bed. But it was fun, and serious accidents were more rare than one would expect.

In bad weather, pilots normally followed convenient railway lines, coming down low over stations to read where they were on the name-boards. Sometimes the weather or mechanical trouble necessitated landings *en route;* but the planes came down fairly slowly and did not need long landing or take-off runs. So this was not serious either.

From such beginnings have grown the airlines of today. Improvement was, in fact, rapid, especially when smaller airlines began to combine to form single national airlines,

like our own pre-war Imperial Airways, which was created by the Government in 1924 by the amalgamation of four of our hard-up small private companies. With more money available, it was possible to buy bigger air liners, so that passengers could sit in proper cabins, with tables and chairs, and with stewards to serve drinks and meals during flight. In time, even the pilot was given a proper enclosed cockpit and, from that moment, the old leather coat, helmet, goggles and gloves—the symbols of his profession—began to give way to smart navy-blue uniforms, peaked caps and gold braid.

Greatest of all the air liners of the early 1930s were undoubtedly the Handley Page Hannibals—great biplanes with so many struts and wires that one foreign designer laughingly said they had 'built-in headwinds'. But even when modern low-wing monoplane air liners with retractable undercarriages, like the Douglas DC-2, came along, they continued to plod between London and Paris at a steady 98 m.p.h. In fact, they carried more passengers out of Croydon than all other airliners combined, because they were safe, comfortable and so leisurely that there was time for a full-course dinner during the trip. Each of these wonderful old biplanes flew more than a million miles without ever hurting anybody, until the last of them disappeared without trace on a wartime flight over the Persian Gulf.

But progress could not be halted and the DC-2 introduced a completely new era of fast airline travel in 1934. From it came the famous DC-3 Dakota. Whilst, in England, Imperial Airways' new fleet of Short Empire flying boats carried passengers all the way from Southampton to South Africa, India, then Australia and New Zealand

and, finally, even began experimental services across the Atlantic to Canada and New York.

The war halted civil airline progress for five years; but indirectly it brought about a further revolution in air travel. Big four-engined transports developed for war—the DC-4 Skymaster, Constellation and Stratocruiser—became the first of a new generation of post-war air liners. Radio and radar sets that had guided bombers to their targets, enabled them to destroy with pin-point accuracy factories they never saw, and to be 'talked down' to safe landings in bad weather, were available to make civil flying safe and practicable in all weathers.

Meteorological services had improved beyond measure. Atlantic flights had become mere routine. Thousands of ex-military Dakotas were available at give-away prices to help airlines rebuild their fleets; and thousands of young war-trained pilots, navigators, radio officers and flight-engineers wished for nothing better than to continue their flying with a plane-full of passengers instead of bombs. Most important of all—although they killed the ever-popular flying boat—hundreds of big concrete runways built in almost every country of the world for war, now became available as ready-made airports for the world's civil airlines.

Everyone expected a boom in air travel, and they were not disappointed. But fares were high and competition intense. Airlines began to vie with each other in the standard of luxury they offered. For a few extra pounds wealthy passengers could walk along a red carpet into their aircraft, eat fabulous six-course meals, with unlimited free champagne and other drinks, sleep in comfortable beds as they crossed the Atlantic at 20,000 ft 'above the

weather', and receive free cigars, 'overnight bags', cosmetics and orchids.

It was all very impressive until one day some bright airline chief realized that such luxuries were keeping fares so high that almost everyone who could afford to travel by air was already doing so. If airlines were to continue to expand, they would have to attract people who could not afford the 'extras'—people who would be only too glad to fly in aircraft without any 'frills', if they could do so at the lowest possible cost.

The two great American international operators, Pan American World Airways and Trans-World Airlines wanted to get started immediately on cheap-fare 'tourist class' or 'air coach' services in 1948. But they could not because, like most big airlines, they are members of the International Air Transport Association (I.A.T.A.), which fixes all fares to prevent price-cutting 'wars' that would lead to bankruptcy for everyone. And most members of I.A.T.A. were not ready for cheap fares. Their aircraft were already operating to capacity at standard fares and they saw no sense in reducing their earnings before they had a chance to buy extra 'planes.

Nevertheless, Pan American won the day, and in September, 1948, were able to start the world's first tourist service between New York and San Juan, Puerto Rico. Accommodation was less spacious than before, and no hot meals were served in flight. But within a year, they were carrying three times as many passengers on the route, without any decrease in first-class bookings, which on the contrary increased impressively.

Other airlines joined in. Capital began the first regular night air coach flights between New York and Chicago,

at a fare of $29·6 instead of the normal $44·1. T.W.A. started a coast-to-coast service across America at $110 compared with the first class fare of $150. Flights were made at the unpopular hours between eleven o'clock at night and five in the morning, when air liners normally wasted time on the ground. There were no meals, no reservations and less personal service. The aircraft used were often old ones, no longer able to compete with the sleek post-war air liners used on first class services.

But none of these things mattered. For the first time the average American could afford to fly and he began to choose the airways in preference to the railways. Business became so good that the old planes were retired and modern, high-speed air liners introduced on tourist services. The luxury of their interiors was cut down to accommodate 30 per cent more passengers, and in 1950 some 1,056 million passenger-miles were flown by these aircraft, adding $43 million to the airlines' earnings. At the same time, revenue from first class services increased by $14 million, proving that most of the tourist passengers were new customers.

It was almost unbelievable, and some airline chiefs still insisted that cheap fares might be all right for short routes inside America, but would never work on long international services, where even tourist fares would still cost more money than the average man or woman could afford.

The first day of May, 1952, proved them wrong. On that date, Pan American, T.W.A., Air France, B.O.A.C., K.L.M., Sabena, Scandinavian Airlines, Swissair and Trans-Canada Air Lines all introduced transatlantic tourist services with a New York-London return fare of

about £173 instead of the usual £254. Some of them converted their existing air liners into air coaches by removing sleeping accommodation and moving seats closer together. Others bought brand-new air liners. B.O.A.C., for example, converted Constellations into 68-seaters for their *Mayflower* service; while Pan American set up in competition with a *Rainbow* fleet of new 82-seat Douglas DC-6B's.

Results were staggering, even on what had long been the world's busiest travel route. More people journey between the United States and Europe than on all other travel routes combined, and in 1950 seven out of every ten of them went by ship because it was cheaper. By 1953, far more people were flying the Atlantic than going by boat. By 1954 also, inside America, airline passenger revenues were exceeding those of the railways.

There is no longer any doubt of the value of tourist travel and many airlines operate two distinct fleets for first class and tourist services. B.O.A.C., for example, have ordered jet-powered de Haviland Comet 4's for very fast luxury long-distance services, and Bristol Britannias, powered by propeller-turbine engines, for slightly slower, but little less comfortable tourist services on the same routes. The great load-carrying ability of the Britannia will, in fact, enable it to carry up to 101 passengers nonstop from London to New York at 385 m.p.h.

British European Airways have gone even further than B.O.A.C., for all but two of their services are cheap-fare tourist class, even when operated by their Elizabethan and Viscount aircraft—the finest and most modern fleet of air liners in Europe. As a result, they now carry more than 2 million passengers a year, for people have come

to prefer the spaciousness of the 47-seat Elizabethan and the smooth, fast, vibrationless comfort of the propeller-turbine Viscount.

Nor is it just the passengers who are benefiting from Britain's pioneering in turbine-powered air liners, for B.E.A. made a profit of £3,933 out of total earnings of £3,152,444 in their first year of Viscount operation—an unprecedented achievement, for few air liners show a profit from the moment they enter service.

With such aircraft landing and taking off every few minutes, with little more fuss or ceremony than at a railway station, the London Airport of today contrasts vividly with Croydon in 1920.

More than 500 aircraft belonging to dozens of airlines fly in and out of London on peak summer days, and well over 2,000,000 passengers pass through the Airport each year. The rich and famous travel on luxury services, like B.O.A.C.'s *Monarch* and Pan American's *President* —both flown with Stratocruisers. But far more numerous are the tourist passengers, flying to see their relatives and friends overseas, cramming thousands of miles of low-cost travel and adventure into a fortnight's holiday. There are also ships' crews returning home after delivering vessels to foreign ports; children by the thousand, flying to spend holidays with their parents overseas; soldiers moving by air instead of troopship; people of all colours, races and creeds, travelling speedily and cheaply to every corner of the world, showing how the air ocean unites all peoples, passing easily over national borders and natural barriers.

Not only the aircraft they travel in and the Airport they pass through are different from Croydon in 1920.

The elaborate precautions taken to ensure their safety and comfort during every stage of their journey are altogether new and awe-inspiring.

Long before passengers reach the Airport, the air liner in which they are to fly will have been subjected to complete and careful inspection and overhaul in the great maintenance hangars on the far side of the runways. It will then be taxied over to the parking apron and refuelled, while the stewardess supervises loading of all the food, drink and supplies needed by passengers during a long flight.

Meanwhile, the aircrew will complete their preparations. Highly skilled briefing officers and 'met-men' will tell them the sort of weather they are likely to encounter; the best route to follow and the best height at which to fly; conditions at their destination; any areas that must be avoided because of military shooting practice, and so on. Full details are given them of Traffic Control regulations in force; equipment for bad weather and night landings at airfields along their route; what radio and radar aids are available to guide them; and what wireless signals are being used.

These services are free to airmen of every nation, 24 hours a day, their object being not merely to help the aircrew but to ensure the safety of passengers. In fact, if the officers of the Briefing Unit were not satisfied with the efficiency of a crew or the airworthiness of an air liner they could forbid it to take off. Needless to say, such a possibility is very remote!

It's 'safety first' in the air too. No air liner is allowed to take off until the Traffic Control officers in the tall Airport Control Tower are satisfied that the runway and

the air above it are clear. Then the pilot has to follow a carefully planned route, usually down control area 'sky tunnels', in which all aircraft fly at different precise heights to avoid danger of collision. The air liner's course down the tunnels is tracked by radar, and the pilot has to send back regular reports of his position, height and speed. At no time throughout his flight need a pilot be out of touch with ground stations, which will help him check his course and, in bad weather, guide him in to a safe landing.

So much for the present. What of the future?

Certainly the jet-liner is here to stay, and the first-class high-speed services of the future will be flown by big 100-seaters able to fly non-stop services from London to New York and back in a day. Tourist services will probably be flown in propeller-turbine air liners, cruising comfortably above the weather at 385 m.p.h. For services up to 350 miles in length, the big helicopter air bus will be supreme.

All this is inevitable—so is continued improvement of safety aids. Already the American Air Force have flown transport aircraft across the Atlantic under radio control, without any human pilot at the controls. One day, it may be possible for all air liners to be flown this way, under the complete control of ground stations, eliminating all possibility of human error by the pilot, or of collision. Looking even further ahead, vertical take-off aircraft—streamlined developments of Rolls-Royce's 'Flying Bedstead'—may make it possible to dispense with big airports, by taking off with no more forward run than a helicopter. Flying will be more comfortable too, for some air liners are already being fitted with special radar sets

which, as well as aiding navigation, can detect storms in the aircraft's path, enabling their pilots to fly round or through 'holes' in the bad weather and so avoid 'bumpy' conditions.

Designers, engineers, scientists, radio and radar technicians, aircrews, ground crews, briefing, meteorological and traffic control officers—these and thousands of other men and women, all expert at their particular trade or profession, are enabling the airlines to do a tremendous job today. In 1937, when aircraft carried an average of five persons, a total of 2½ million passengers were flown 165 million miles by the airlines of the world. In 1953, with an average of 25 persons per flight, more than 52 million passengers—a million a week—were carried 1,170 million miles. When helicopter air bus services start in a few years time, who can guess how many more tens of millions will choose to travel the quick, comfortable, safe, easy way—the airways.

Chapter Five

FLYING THE MAIL

OF ALL THE jobs being done by aeroplanes today, none is more important, or brings more happiness than the air mail service. No longer need we feel cut off from our family or friends, even if they are on the other side of the world, for an air mail letter reaches Canada almost as quickly as a neighbouring town, and even Australia is only four days away.

More than 15,700 tons of mail are handled at British airports each year. If you do not think this is a lot, remember that the average air mail letter weighs less than an ounce. Multiply 15,700 by 2,240 to get the number of pounds carried, and then multiply the result by 16 to bring it to ounces. The result is quite a lot of letters!

What is more, air mail has played a very big part in the steady development of air transport; because the airlines, especially in America, are well paid to carry it; and without this money some of them would not have survived difficult years when new aeroplanes were expensive and profits from passenger-carrying small or even non-existent. Again, in many cases, air mail services were started over difficult routes, across mountains and oceans.

long before passengers were carried. The experience gained played a big part in ensuring the later success and safety of passenger services. And some of the greatest pilots in aviation history, including Charles Lindbergh—first man to fly the Atlantic solo—began as flying mailmen.

They had to learn the hard way, at a time when there were very few of the safety aids that we depend on today; and many of them were killed trying to get the mail through in bad weather. But ever since men started writing to each other, letters have had to be carried by the fastest possible method, and for that reason, messages were even carried by balloon in the 19th century, particularly during the siege of Paris in 1870. But it was not very satisfactory, because it was possible to send a letter to one's friend only if the wind happened to be blowing in his direction and if the balloon could be persuaded to land at the right place. Naturally, an air mail service under such conditions was unacceptable to the Post Office, charged with the safe, speedy delivery of Her Majesty's mail!

So it was not until the aeroplane was invented that the first official air mail flights were made. Surprisingly they took place in India. Sir Walter Windham, who had taken eight aeroplanes to that country for demonstration at the Allahabad Exhibition in 1911, was asked by a local clergyman if he could help to raise funds for a new hostel. He suggested an air mail service across the Ganges from Allahabad to Aligah, by which the public could send either letters to their friends or donations to the clergyman's fund. The Indian Government approved the idea, and a large number of letters were carried, each stamped

with a special postmark. The clergyman got enough money for his hostel, and the envelopes carried on the service and signed by the pilot, Monsieur Pequet, were soon fetching £25 each from stamp collectors.

The next official air mail service, also organized by Sir Walter Windham, was the famous Coronation Mail flown in England to commemorate the crowning of King George V. More than 100,000 letters and cards, each bearing a picture of an aeroplane in flight over Windsor Castle, were carried from Hendon to Windsor; and specimens can be bought today for as little as fifteen shillings.

But aeroplanes were still frail unreliable contraptions of stick-and-string in 1911; unable to fly in strong wind or for long distances. So it was not until after the 1914-18 War that air mail services really got under way. In Europe in the early 1920s, sacks of air mail were usually stuffed in odd corners of the fuselage of passenger-carrying aircraft; but in America the Post Office wanted specialized high-speed mail flights. The story of these is at the same time one of the most amusing, gallant and tragic in aviation history.

They started in 1918, when the U.S. Post Office began flying mail experimentally between Washington, Philadelphia and New York, using 17 ex-military D.H.9 bombers. It was next decided to open a regular service between New York and Chicago, provided the pilots would fly in any kind of weather. Despite the open cockpits of their aircraft, and absence of any kind of reliable navigation aids or emergency landing fields, they said they would. Thirty out of the original forty pilots lost their lives trying to keep their promise.

Their ambition was to carry mail from coast to coast

across the continent in half the time taken by train. On 15th May, 1919, they inaugurated the Chicago—Cleveland run; followed by the 'graveyard stretch' over the Allegheny Mountains between Cleveland and New York. Gradually the route was extended to Omaha and San Francisco and, by 1921, flying the mail by day and putting it on trains at night, the New York—San Francisco mail time had been cut from 90 hours, by rail alone, to 72 hours by air and rail.

Unfortunately, the U.S. Government decided this was not good enough, despite the fact that nowhere in the world was there a better service. It looked like the end of the flying mail, and probably would have been but for the Assistant Postmaster, General Otto Praeger, and his volunteer pilots, who decided to fly the mail for one night, on the anniversary of Washington's birthday (22nd February), even though they had no beacons to guide them, no landing lights or navigation aids other than bonfires lit by friendly farmers and townspeople.

The result is one of the epics of aviation. Both westbound flights were cancelled because of unflyable weather over the Alleghenies. One of the eastbound planes crashed in Nevada. The other eastbound mail was carried by a succession of pilots from San Francisco to Reno, Salt Lake City, Cheyenne and North Platte, Nebraska, where it was taken over by a young pilot named Jack Knight, just out of hospital after breaking his nose in a rough landing a week earlier. Despite a broken tailskid which held him up for three hours, and snowstorms, Knight flew through the darkness to Omaha, only to discover that the pilot who was to fly the next stage to Chicago had failed to put in an appearance.

It looked as if the gallant attempt to save the mail service had failed. Then Knight took a decision that was destined to turn him overnight into an American hero. Although chilled to the bone, he said he would carry on the flight to Chicago himself, despite the fact that he had never flown over the route before, even in daylight.

There were no longer any bonfires to guide him, and proper airline maps were non-existent, because there were no airlines. A strong crosswind made the wooden biplane buck and swing and he had to fly it crabwise to hold his course while peering over the side constantly to try and identify railways and roads shown on his road map. After a hazardous landing at Iowa City, he refuelled and took off again for Chicago. Fortunately by the time he arrived there the early morning fog had cleared and it was daylight. For the first time the little 400 h.p. Liberty engine coughed and then stopped. But it did not matter. He glided down and made a good landing, to find himself surrounded by cheering crowds of people who had heard of his gallant exploit.

Before he had left the airfield, the mail was safely on its way to Cleveland and New York, where it arrived 33 hr 20 min after leaving San Francisco.

In the face of such success, and a new wave of public enthusiasm, the U.S. Government could hardly close down the air mail service. Instead, it produced £300,000 to continue and expand the service and to provide proper beacon lights along the routes. And from that humble start has grown the great U.S. domestic airline system of today, carrying 28 million passengers for a total of 14,600 million passenger-miles each year over 76,761 unduplicated miles of routes, made safe by every kind of

electric, radio and radar beacon, and navigation aid. As well as passengers, the sleek, comfortable 300 m.p.h. air liners carry more than 1,367,000,000 letters and 18,000,000 parcels each year, weighing a total of 38,000 tons. Another 7,800 tons are flown from America to destinations in 95 overseas countries, the time taken by a letter to fly from New York to London being less than half that taken by the first historic San Francisco—New York day and night mail flight of 22nd February, 1921.

Today we take air mail so much for granted that it is difficult to believe that only 30 years ago a letter received by air was something to boast about for weeks! Post Offices all over the world have shown their appreciation of the achievements of the flying mailman by depicting on postage stamps almost every important aeroplane and event in aviation history. There are stamps bearing the portraits of Pilâtre de Rozier, first man to fly, the Wright brothers and Cierva, inventor of the Autogiro; others depicting the Wright biplane, Blériot's monoplane, Lindbergh's *Spirit of St. Louis*, even Spitfires and Lancasters, and the Comet and Sabre jets of today. Some, like the stamp used on the mail carried by Hawker on his unsuccessful attempt to fly the Atlantic in 1919, are worth hundreds of pounds; but a fine collection of less rare air mail stamps can be made for a few pounds.

In Great Britain, of course, our Post Office seldom issues special stamps; but airlines have been allowed to produce specially printed envelopes to commemorate pioneer flights. One of the most interesting of these is the envelope printed by B.E.A. and carried on their first helicopter air mail service in East Anglia on 17th October

1949, because it marked the start of a new era of air mail flying.

With its ability to land almost anywhere, the helicopter promises to revolutionize air mail services, and the Americans, in particular, were quick to follow B.E.A.'s example. In Chicago, six Bell Model 47 two-seaters operated by Helicopter Air Services carry mail every day of every week between Midway Airport, the main post office building and 55 suburban areas. In their first 4½ years, they carried more than 5,500 tons of mail, including 440,000,000 letters.

In 23,250 hours flying, the six little aircraft covered more than 1,238,000 miles without accident, although 18 landings have to be made each day on the post office roof, which is 238 ft above street level. The suburban districts are served by three circular routes which are flown three times a day. They are 106, 102 and 89 miles long and the helicopters take from 45 minutes to two hours on each trip. At the suburban stops, they land in fenced-off heliports and, after a quick exchange of cargo, are airborne within a couple of minutes and heading for the next stop.

Records show that people in the Chicago area get their air mail from six to 36 hours earlier as a result of helicopter delivery, and their appreciation is shown by a 300 per cent increase in the number of air mail letters posted.

Sabena Airlines in Belgium met with similar success when they began operating three Bells on mail flights between Brussels and eight other Belgian cities, over a 268-mile circuit. As a result, in 1953 they opened the world's first international helicopter passenger and mail services with bigger Sikorsky S-55 helicopters, which they

now operate to Holland, France, Luxembourg and Germany.

It is only a start, for when twin-engined helicopters like the big 44-seat Fairey Rotodyne become available, helicopter air mail services will radiate out of London to every big city within 300 miles radius—to Paris, Brussels, Amsterdam, The Hague, Edinburgh, Belfast, Jersey, and a score of other important centres. And Britain's new generation of jet and turbo-prop airliners will shrink still further the long-distance routes from Britain to every corner of the Empire and foreign lands, until no place in the world is more than 24 hours from London.

Then air mail postage costs will begin to drop also. Britain made a dramatic step in this direction in 1937, when the Empire Air Mail scheme was introduced. Letters to every part of the Empire served by Imperial Airways' fleet of superb Short 'C' class flying boats were carried by air at a cost of only 1½d. per half-ounce. Then came the war, the service was suspended and, today, it costs 12 times as much as that to send a letter by air mail to Australia or New Zealand. But, even then, who counts the cost when the flying mailman can encircle half the world between Monday and Friday?

Chapter Six

BEANS, BEDS AND BULLDOZERS

LET US GO now on a visit to the most interesting buildings at London Airport.

An Air-India International Super Constellation has just arrived from Bombay. Already, before the last passenger has stepped down from its lofty cabin, ground crews are busy unloading luggage, sacks of mail and boxes of freight into an incredible variety of lorries, vans and trolleys.

We know all about passengers and mail, so let us follow the boxes of freight and find out what is in them. It is not as easy as it sounds, because the huge freight sheds are in the Customs area, and we need a special pass to get inside. But it is worth the trouble, for the riches of the whole world pass through their steel doors—not riches in the sense of gold and jewellery, which are kept in a special Safe Custody Room, but the natural and man-made products that make life easier and more pleasant for all of us.

Take, for example, those boxes from the Air-India 'Super Connie', which contain sandalwood oil, hog bristles, mica and mangos. These may seem pretty queer sort of 'riches' to you; but sandalwood oil is one of the

costliest ingredients of high quality soap and perfume, worth 70 shillings a pound, and Air-India have flown well over £1,000,000 worth of it to London.

Similarly, the brush you use to tidy your hair may well contain Indian hog bristles; your shoes may be sewn together with them; and the electric iron used to press your clothes probably contains some of the five tons of mica which Air-India carry here each year.

Of course, not many air cargoes are so mysterious and, looking around the freight sheds, there are plenty of things we recognize right away—cheese from Holland, dress materials from France, motor car engines from Italy, even a boomerang for some lucky youngster from a pen friend in Australia.

It is rather exciting and adventurous to be surrounded by things from so many far-off lands, reminding us of the remark of Dr. Albert Plesman, founder of the great Dutch K.L.M. airline, that 'the air ocean unites all peoples', for there are freight sheds, just like those at London, on the edge of nearly every big airport in the world.

While that Air-India Super Constellation was winging its way towards London, a Dakota may well have landed at Nairobi with a ton of razor blades from Copenhagen, and taken off again with a load of pyrethrum extract for manufacturers of insect-killer in Britain. These are typical air cargoes, but you will probably be surprised to learn that, on the other side of Africa, French beer bottle corks have been flown to Lagos by the ton. Lobsters are ferried regularly from Stavanger to Amsterdam; yeast is carried from Amsterdam to Lydda; furniture from Hamburg to Teheran; glass insulators from Liverpool to Gothenburg;

the latest fashions in ladies' dresses and coats from one side of America to the other—an endless variety of cargoes to an endless succession of places.

It sounds like big business; but, to be truthful, it is not. All the air freight that passed through London Airport in 1954 totalled a mere 24,739 tons, which would hardly fill three good-sized cargo boats. Only 93,142 tons were handled at all 40 of Britain's main airports and about 51 per cent of that resulted from a single service—the vehicle ferry between England and France.

This is all the more surprising when we compare aviation with surface transport; because shipping companies and railways rely on freight carrying for much of their profits, and many experts believe that airlines will start to make money only when they too concentrate on packages as much as passengers.

On the other hand, we must not be too hard on the airlines. The first railways carried only passengers, in considerable discomfort, from town to town; and the first boats were hollowed-out tree trunks, intended only to carry their makers across a river. It took time before efficient cargo-carrying boats and railway trucks were developed; and it has taken time to produce the first specially designed freight-planes.

Until about 10 years ago, anyone who wanted to carry cargo by air simply took the seats out of a passenger plane to convert it into a makeshift 'freighter'; and even today a large proportion of air freighters are converted air liners such as DC-3 Dakotas, and DC-4 Skymasters. This is about as sensible as ripping the seats out of a railway coach every time we want to carry a load of coal from South Wales to London, because air liners are fitted

with a lot of expensive equipment designed solely to keep passengers happy and comfortable.

Their sound-proof cabins are not needed when the payload consists of a couple of spare aero-engines; nor are costly air-conditioning or carpets on the floor appreciated by cartons of nylon stockings or toy tanks. Indeed, every pound of sound-proofing, air-conditioning equipment and carpets that can be dispensed with means that an extra dozen pairs of nylons or two more toy tanks can be packed aboard.

Passengers want comfort and speed. Air freight demands big, spacious cargo-holds, large loading doors, a strong cabin floor to support concentrated loads. No single type of aircraft can do both jobs efficiently.

Realizing this, after the war the Bristol Aeroplane Company built a twin-engined aeroplane which they called the 'Freighter', solely for cargo-carrying. It was far from handsome, with its massive bull-nose, box-like fuselage, broad angular wings and tail and 'old-fashioned' fixed undercarriage. So, in an age of speed and streamlining, nobody seemed keen to buy it, although its cruising speed of 166 m.p.h. was as good as that of the Dakota air liners which formed the backbone of the passenger-carrying fleets of many airlines at the time.

Gradually it began to dawn on the more enterprizing airline operators that the Freighter, because of its big nose-loading doors and 2,200 cubic feet of cabin space, could accommodate bulky cargoes that would go into no other civil transport. A few were sold; then some more. In England they made possible the cross-Channel car ferry; in Australia the Air Beef scheme; in Canada the quick transport of snowmobile vehicles to the far North; and

in France the regular ferrying back to England for repair of damaged R.C.A.F. Sabre jet fighters. As a result, the 'ugly duckling' is in service today in large numbers throughout the world, and still in production at Bristol long after the assembly lines of many of the more glamorous post-war air liners have been closed down.

The Freighter has, in fact, set a fashion for cargo-carrying aircraft that will be difficult to improve, and the big new four-engined, double-deck Blackburn and General Aircraft Beverley, ordered in quantity for R.A.F. Transport Command, is basically a much larger version of the same idea. Main innovation is that its doors are at the rear instead of in its nose, enabling guns, jeeps and supplies to be dropped out of the back by parachute during flight.

The Americans have followed the big, bulky Freighter idea with their Globemaster and Lockheed C-130 transports; but, with much longer distances to cover, speed is more important in the United States and undercarriages have been made retractable to gain a few extra miles per hour. On the average freight run, however, speed is secondary to low freight charges, and it is no more sensible to use the fastest type of aircraft than it would be to couple the finest railway passenger locomotives to a goods train.

Economics play a big part in the whole story of air freight. Occasionally, as in the case of the Berlin Air Lift of 1948-9 goods are carried by air regardless of cost, because they could not possibly be delivered in any other way. The most uneconomical cargoes of all—'bulk' goods like coal and oil, a few pounds worth of which occupy a vast amount of room—were flown in then, to keep the

people of West Berlin alive and at work when all roads, railways and waterways had been closed by the Russians. But such things are not carried in normal times, for even a specially designed cargo-carrier like the Bristol Freighter costs about eight shillings a mile to operate, so that it would cost £75 in freight charges alone to fly five tons of coal from London to Paris in one of these aircraft.

In general, goods are sent by air because it is cheaper or more convenient than surface transport; because they are needed urgently at their destination; or because they are so perishable or fragile that they could be sent in no other way. In addition, gold, money and precious stones often go by air because there is less likelihood of their being stolen or lost. Thus, in 1950, the entire new currency of the Kingdom of Jordan was flown from Blackbushe in Surrey to Mafrak in Jordan aboard Vikings belonging to the British independent company, Airwork. Banknotes, gold and silver coins were printed and minted in England, rushed to the airport and put aboard the Vikings, where they were well out of reach of potential robbers until they arrived at their destination, except for the short time spent refuelling *en route*, when the aircraft was put under guard.

Goods which go more cheaply by air are mainly those which otherwise need expensive crating and packing, such as furniture. There have been some pretty remarkable 'flying carpet' operations, especially in America where Eastern Air Lines flew 100 tons of furniture from Miami to equip the £2½ million Caribe-Hilton Hotel in San Juan, Puerto Rico. Thirty planes were used to lift the 600 beds, 304 tallboys, 352 dressing tables, 3,000 chairs and sofas, 355 standard lamps, carpets and other items.

In Europe, Silver City Airways have flown loads of export furniture from Southend to Brussels, eliminating packing costs, and the possibility of damage in transit. They also flew more than 200 roomsful of office equipment to France when the North Atlantic Treaty Organisation moved its headquarters from London to Paris.

Australia too has its flying removal men, and several families who have moved house from the mainland to Tasmania have flown out over the Bass Strait, complete with all their belongings, by Australian National Airways Freighter, saving a lot of time and money. One person who did this was the headmaster of the school on Flinders Island, off the N.E. corner of Tasmania, who flew out with all his furniture and his motor car. On the return flight, a similar load was carried to Launceston for the island's retiring headmaster.

This was an ideal arrangement, because each family had to pay only for a one-way journey. If there had been no return load, the new headmaster would have had to pay for the aircraft to fly back empty, and this would have made the move very expensive. In a place like Tasmania, however, it is usually possible to find somebody who will share expenses by providing a return load, and many of the Freighters return to the mainland with such things as bales of wool, 500 tons of which are flown to Melbourne after the Tasmanian annual wool sales.

All sorts of other things cross the Bass Strait by air. A.N.A. fly butter and crayfish regularly to Flinders Island, and when the island's airstrip was extended they carried out a 9,264 lb road grader to help in the work. It was the heaviest single item ever air-freighted in Australia at the time. The longest item—a 24 ft long

refrigerator for an ice cream company—was also ferried to Tasmania by Freighter; and other record loads have included a huge fruit-canning machine and a five-ton ironing machine for the Launceston Hospital laundry.

Australia is not the only country where such things are carried by air, and oil companies in particular use air transport a lot for moving their heavy equipment in isolated areas, where surface transport is slow, expensive or even impossible. Typical was the 11,000 lb mud pump which the Shell company flew over dense jungle to a small settlement near a new oil well in Ecuador, which was completely inaccessible in any other way.

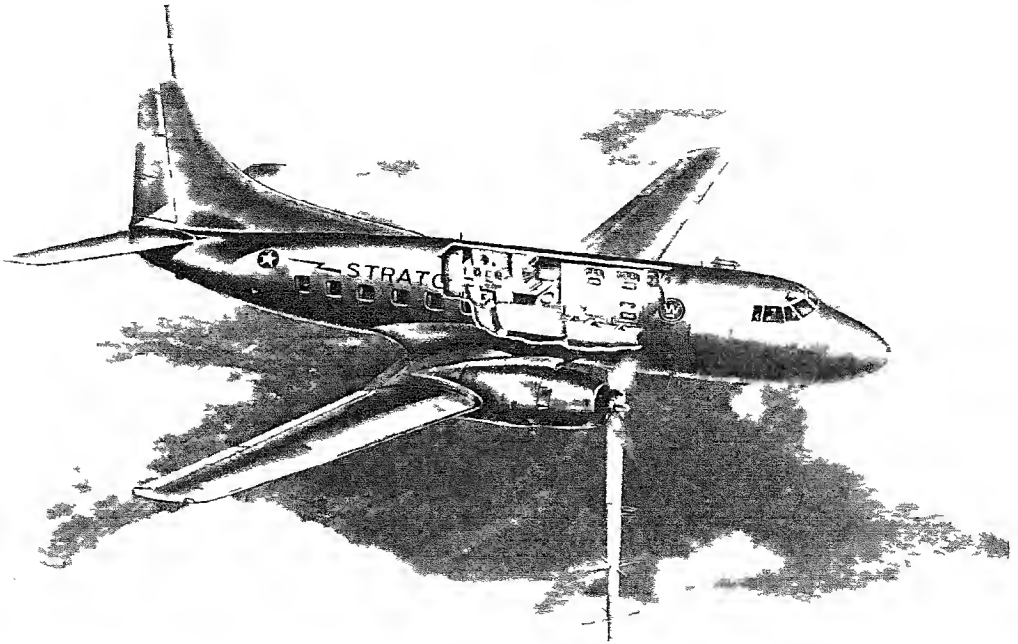
In each case, these things were sent by air because it was cheaper or more convenient than surface transport. Other items, some of them equally heavy or cumbersome, are air-freighted over routes where surface transport is cheap and efficient solely to save time, because, to their owners, time *is* money. The most frequent cargoes of this kind are pieces of machinery for ships that have broken down in far-off foreign ports. Every day these ships remain in harbour costs their owners hundreds or even thousands of pounds, because their crews have to be paid even though the vessels are earning no money. Before the war, the best the owners could do was to send out replacement parts by the fastest boat or overland route. Today, they can telephone any one of a score of airline companies and, provided the parts will go into an aeroplane, arrange to have them flown out to the crippled ships in a matter of hours.

It all works very smoothly, as was proved when the New York office of a major shipping line received the following cable from Calcutta: 'Engine breakdown.

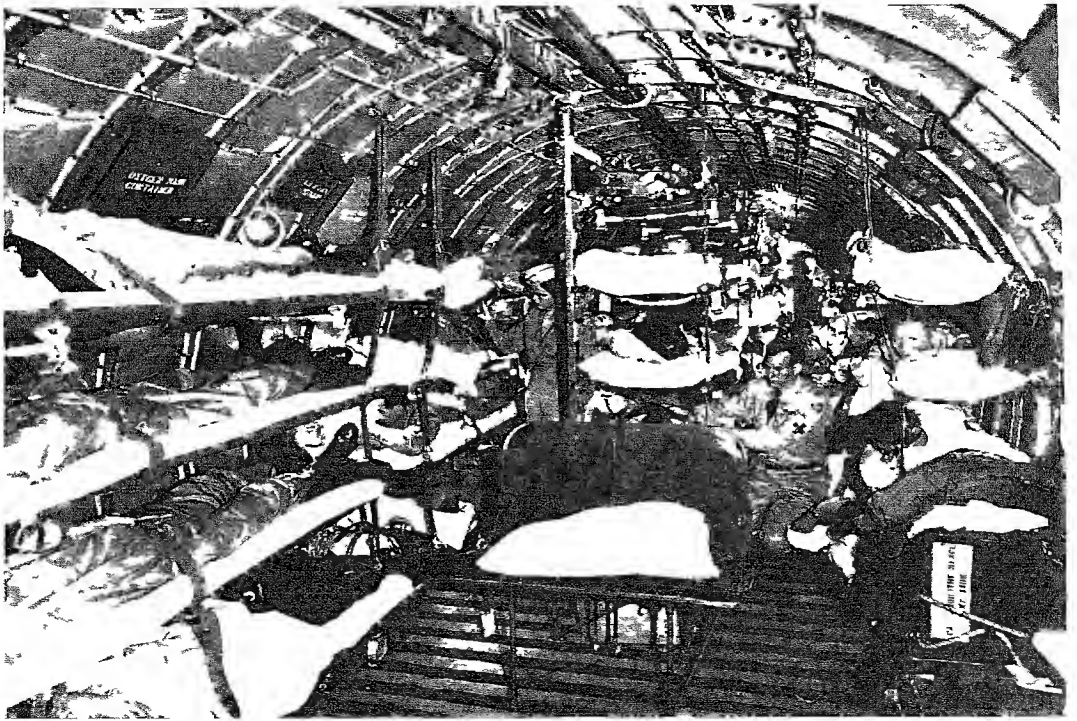
Urgently request ship turbine Calcutta. Signed SS *Devon Victory'*. Within 24 hours another cable went to the captain of the ship to say: 'Turbine parts shipped today K.L.M. air cargo. Arriving Calcutta in three days'. Such an operation, costing perhaps £1,500, might well save the shipowners three times that sum in wages, supplies, harbour charges and other expenses.

Some of the parts are pretty big. An average size ship's propeller shaft weighs anything from four to seven tons; so does a turbine rotor. The propeller flown to Bermuda for the SS *Leondros* by Colonial weighed 1,580 lb. The main engine turning wheel carried to a stranded British tanker at Hamburg by Silver City Airways weighed only a ton, but was 8 ft 3 in in diameter—five inches wider than the Freighter's cargo hold. Little things like that present no problems to the air cargo companies, and within a few hours a special frame had been made to carry the wheel diagonally in the aircraft's freight hold.

Sometimes even the biggest plane cannot accommodate an urgently needed piece of equipment: but Daimler Airlines—one of Britain's four pioneer companies—thought up an answer to this problem way back in 1921. Realizing that if one of their air liners broke down at a foreign aerodrome they would lose money just as quickly as a shipowner with a crippled steamer, they fitted one of their aircraft to carry a spare engine. It would not quite go into the cabin, so they made a hole in one side, through which the engine's propeller shaft could poke during flight. More recently, Pan American have flown spare four-bladed propellers for their air liners in much the same way, with the ends of two of the long blades poking through the sides of the cabin. And when urgently



Flying TV Station — a cutaway view of stratovision equipment installed on a twin engined aircraft to relay television programmes over wide areas



Inside a Boeing Stratofreighter of the U S Military Air Transport Service flying 79 stretcher patients from the Korean War across the Pacific to America.

needed 6½ ton ships' propeller shafts could be carried in no other way, British independent airline operators simply slung them underneath their Halifax freighters on specially constructed beams and flew them to ports as far apart as in France and Singapore.

But transport companies are not the only people who call on the 'SOS' air freight service to keep their propellers and wheels turning. One of the biggest operations ever carried out by American Airlines involved flying 20 tons of iron laminations from Dallas, Texas, to Schenectady, New York, and back, to repair a 20,000 KVA turbo generator belonging to the Dallas Power and Light Company. Without the generator, Dallas's electricity supply would have had to be cut. As it was, the laminations were flown to Schenectady in ten hours, and in a matter of days the generator was back in service again.

Then there was the time when the American Four Wheel Drive Auto Company was sending a 3½ ton lorry to Cairo by rail and sea, for demonstration to a prospective customer. Just before it was loaded on the ship, they received a message to say that if it was not in Cairo within three days the customer would buy other lorries instead. Quick as a flash, Four Wheel Drive called in Seaboard and Western Airlines, who removed the lorry's body and wheels, stowed the dismantled components in a DC-4 and whisked them to Cairo by the deadline date. The result was an order for 619 more FWD lorries from the Egyptian War Ministry.

More unusual was a package containing two spare bags and a supply of treacle lubricant carried by B.O.A.C. to New York when the Dagenham Girl Pipers suffered from burst bagpipes! But the most important 'SOS' cargoes

of all are, of course, medical supplies and equipment needed urgently to save lives. Many of them could not, in any case, be carried in any other way, because they are too perishable or fragile to be sent by the usual surface methods.

Other goods that come into this category include food, flowers and newspapers. Nothing is more dead than yesterday's news, and it is hardly likely that foreign newspapers and magazines would have such a large sale in London if they had to come by comparatively slow boat and train services. Similarly, air freighting brings the Scilly Isles' famous daffodils to the mainland on the day they are picked, ensuring perfect freshness and longer life when they are bought to decorate our homes. K.L.M. alone carried no fewer than 765 tons of Dutch flowers to other countries in 1953; and it takes a lot of flowers to weigh a ton!

Everything from furniture to flowers, from razor blades to rowing boats, goes by air today, and although the total weight of air cargoes is infinitcssimal compared with surface cargoes, it is growing every day. The possibilities are limitless, for Britain alone imports well over a million tons of food, fuel, supplies and equipment every week of every year. Much of this cargo will one day be carried by air, just as more and more passengers are turning to air travel. The shipping companies realize this, and several of them have bought large interests in independent airlines, to ensure that the changeover does not eat into their profits. Thus, the P. & O. line have shares in Britavia Ltd, the company which controls Silver City Airways and Aquila Airlines—Britain's only flying boat operators. Furness-Withy have a major interest in Air-

work Ltd; and the Clan Line have linked up with Hunting Air Transport to form a £1,000,000 holding company. The experience and capital of these famous shipping lines, combined with the enterprise of the airlines, will speed the growth of air transport and we can expect big developments.

One possibility is that airlines will begin 'tramp' services, like steamship companies, flying from airfield to airfield, picking up whatever cargoes may be waiting at each port of call. But this will depend on more and more exporters in every country becoming airminded; for it would take a brave operator to fly a big freight plane 6,760 miles to Singapore, or to some out-of-the-way place, in the hope that there would be a cargo waiting for him to fly back.

Such operations are possible, however, as Eagle Aviation proved when they carried six tons of Christmas mail to Japan for British troops in 1951; flew from there to Hong Kong, where they picked up 30 Philippine seamen destined for Brazil; and finally returned from Brazil to Britain. They used a wartime Avro York for this 31,750-mile round flight; but it was hardly an ideal freight plane. In fact, it seems certain that air cargo services of the future will demand three distinct classes of aircraft. On short-haul routes up to about 300 miles in length, the big helicopter will come into its own; the more so because it will need no large airfields. Able to take off from any open space, it will combine the speed of air travel with the convenience of road transport, making possible real factory-to-customer delivery.

Between 300 and 1,000 miles, big, bulky comparatively slow freighters like the Blackburn Beverley will be ideal.

The Beverley can carry 22 tons of payload at a cruising speed of 186 m.p.h., very much more cheaply than any other type of aircraft in the world.

Finally, for long-range freighting, the airlines will need big, fast freight planes. B.O.A.C., which is primarily a passenger airline, has ordered a cargo-carrying version of the turbo-prop Britannia. But a more logical aircraft for a freight-only service would be Lockheed's new four-turbo-prop C-130 transport, which has a big tail-loading ramp and can carry up to 20 tons of bulky freight over long ranges at 380 m.p.h.

Even this aircraft is suitable only for the kinds of cargo flown today, and a completely new class of air freighter will have to be produced before airlines will be able to compete with surface carriers in handling the bulky loads of food, fuel, raw materials and low-priced goods that form the major part of the world's cargo traffic. Perhaps the answer will be huge atomic-engined flying boats, able to encircle the earth on a pound or two of atomic fuel. They could take off and alight on the waterways of the world and, if their wings were made to fold upwards, could be berthed in existing docks and loaded in the same way as a ship, through big hatches in the top of their hull. It may sound fantastic; but jet propulsion and faster-than-sound flight seemed no less fantastic 16 years ago.

Chapter Seven

AIR BRIDGE TO FRANCE

BACK IN 1946 a small independent airline company was formed in England for the main purpose of flying mining engineers to and from Australia, New Zealand and South Africa. Six years of war had had a serious effect on the Empire's mining industry; skilled technicians were hard to find, and it seemed sensible to use air travel to increase their usefulness, by transferring them speedily from one centre to another.

One of the townships in Australia served by the new company's three converted Lancaster bombers was Broken Hill—better known to men in the mining business as 'the silver city'. So the airline became Silver City Airways, and it went about its business quietly and efficiently for the next two years, flying two services a week to South Africa and one to Australia.

Then in the summer of 1948 came an international crisis that nearly sparked off a third world war. Disregarding all agreements made with her wartime allies, Russia closed the roads, railways and canals connecting West Berlin with the British, American and French Zones of Germany. With only the narrow air corridors left open, it seemed as if the people of West Berlin were faced

with the alternatives of starvation or of joining the East Berliners under Soviet rule.

But the Russians, like Hitler before them, underestimated the air forces of America and Britain. Through skies where they had carried bombs a few years earlier, these air forces, assisted by civil airlines, now despatched to Berlin vast fleets of transport planes carrying food, fuel, supplies, machinery—all the thousand and one items needed to keep a city of two million people not only alive but at work. Many 'experts' said it could not be done; that sufficient bulk goods like coal, flour and oil fuel could not possibly be delivered in aircraft designed originally to carry passengers, especially when the winter storms began.

Their answer came eleven months later, in May, 1949, when the Russians, their dream of a Communist-controlled Berlin shattered by a few hundred transport aircraft, re-opened the surface routes into Berlin, so that the Air Lift could be brought to an end.

Altogether 1,583,685 tons of cargo had been flown into the city in the most spectacular, perfectly-controlled air operation of all time. The possibilities of air freighting had been shown in a way that could not fail to impress even the least air-minded person. And among the aircraft that had made it possible were two of the new Bristol Freighters, operated by Silver City Airways.

It would make a good story to say that their work on the Air Lift—which the Berliners called the 'Air Bridge' —gave Silver City the idea of throwing an invisible air bridge across the Channel, between England and France, over which cars and their passengers could travel on holiday or business. Unfortunately, it would not be true,

for the first motor car was flown from Lympne Airport in Kent to Le Touquet in France on 14th July, 1948, when the Air Lift had hardly started, and before the civil airlines were called in.

The only connection, therefore, is that next to the Air Lift—which was more or less a military operation—the air ferry service pioneered by Silver City is the most enterprising and important post-war air freight service, and one which was pronounced by the 'experts' as equally unlikely to succeed.

There is no doubt that it *has* succeeded!

The number of crossings made in the first season was only 30. On a single day in the summer of 1955—2nd July to be precise—Silver City's fleet of Freighters and Superfreighters crossed the Channel 165 times, carrying over 600 vehicles and 1,500 passengers. And even that is only part of the story, for so popular has the service become that the airline has even had to build its own aerodrome at Ferryfield, Dungeness, to cope with traffic.

But let us go back now to the morning of 14th July, 1948, to learn the secret of this almost fantastic success story. Shortly after eleven o'clock a four-seater car turned into Lympne Airport from the main London-Folkestone road. Within a few minutes it had been driven up a ramp into the hold of a waiting Freighter, the passengers had taken their seats in the small cabin at the rear of the aircraft, and it was heading south across the Channel. Within half an hour, the car was in France on the road to Paris.

The terminals for the air ferry have been chosen wisely. Ferryfield, which replaced Lympne as the main British

terminal in 1954, is within easy reach of the most densely populated areas of Great Britain; Le Touquet, apart from its own attraction as a fashionable seaside resort, is a first-class stepping-off point for people travelling to Northern Europe, Paris and the Riviera. Even more important, choice of these two terminals gave the shortest practicable air journey of only 47 miles. Cars are flown only where they cannot be driven, making the crossing as cheap as possible.

From the start, Silver City had the right ideas on making their service pay. They realized, as did the airline chiefs who were battling at about the same time for tourist fares, that the only way to increase business was to cut fares to the absolute minimum. Even this 'minimum' was pretty high at first. There was no regular service. Anyone who wanted his car flown to France simply got in touch with the airline, who worked out the cost on an individual charter flight basis. If the customer had to go on a particular day at a particular time, he often had to pay for the hire of the complete aircraft. If he could fit in his flight with somebody else who wanted to ferry his car across the Channel, the fare would be only half as much. If there was a return load waiting at Le Touquet, the fare might even be less. But it still cost about £27 to fly a small car and two passengers from Lympne to Le Touquet.

Since then, however, as business has increased, Silver City have slashed their fares again and again, until at the time this book is being written, a car the size of a Morris Minor, with two passengers, can be flown to France for only £11 mid-week. This is little more than the boat fare; but look at the advantages. A family from the

north of England can drive down to Ferryfield or one of the other air ferry terminals, be whisked across the Channel in 20 minutes' flying time and be in Paris the same day, without overnight hotel and meal expenses at a British or French port. Customs and boarding formalities are quick and easy. There is no waiting, no queueing, no tips to be paid and the car is fully insured during the journey—an item that normally adds one-third to the surface fare.

Little wonder that more and more people are choosing the air journey. In 1954 a total of over 126,000 passengers and 30,908 motor cars—about one quarter of all the cars that crossed the Channel—went by air. The 1955 total is even higher. Similarly, in 1950 motor cycles and bicycles were carried regularly for the first time as well as cars. By 1953, the service was so good and the fares so cheap that about half of the motor cycles and threequarters of the bicycles that crossed the Channel did so by air ferry.

As the traffic has grown, so have the services offered to the public been improved. Assured of Ministry of Civil Aviation permission to run the ferry as a regular, scheduled airline for a number of years, in 1950 Silver City built new passenger lounges and Customs offices at their terminal airports. Next year, three more Freighters were added to their fleet, to cope with rapidly growing business. Two more followed, and then another, hired from B.E.A. Finally, even these were insufficient and the company ordered a completely new version of the Freighter, tailored to the specialized requirements of the air ferry. Named the Superfreighter, each of these new machines carries three cars and 15 passengers, compared with two cars and 12 passengers in the early Freighters.

More eomfortable seating, better soundproofing, more powerful engines and other improvements offer still higher standards of safety and performanee.

Today, the air ferry fleet eonsists of nine Super-freighters and six Freighters; and will almost certainly be inereased further before long. The original Lympne—Le Touquet service has been replaced by seven new ones—Ferryfield to Calais, Ostend and Le Touquet, Birmingham to Le Touquet, Gatwiek to Le Touquet and Southampton to Cherbourg and Deauville. Between them, they have earried five times as many cars in one day as were flown in the whole of the air ferry's first year.

But the ferry carries more than just holiday-makers and businessmen with their cars, motor cycles and bicyeles. If it did not, the fleet of 15 aircraft would spend most of the winter sitting on the ground with nothing to do. Two or three years ago, some of our biggest motor firms discovered that it was cheaper and easier to export new ears to the Continent by air than by the usual methods. Drivers can deliver the cars to Paris and other eities much more quiekly; so that a slight increase in fares is more than saved by reduced hotel and meal expenses. Continental dealers are happier too. They no longer need to keep a large stock of any partieular model—a telephone eall to London will produce the right car, in the right colour seheme within a matter of hours.

Furniture manufacturers also save money by flying their goods over the Channel, avoiding the need for costly crates and paeking. Regular Sunday 'eheese speeials' are run for importers of Freneh eheese, who, by saving a day or two, ean offer fresher supplies to British shopkeepers who, in turn, ean keep the cheese in stoek longer before

it becomes too ripe. Cushion covers, azalea plants by the million and an endless assortment of other goods fill odd corners of the aircrafts' enormous freight-holds on normal car-carrying flights, and at other times help to keep down costs by filling aircraft that would otherwise return empty.

All sorts of odd vehicles use the ferry, ranging from a 1903 Darracq veteran to the latest 180 m.p.h. Grand Prix racing cars and even sailing dinghies, which are sometimes flown to France by British helmsmen for a quick day's racing against French yacht clubs. First boat carried in this way was the 1,000th Fairey Marine *Firefly* 12-footer on a trailer towed behind a Morris Oxford car, and it was the first time that land, sea and air vehicles had ever travelled together as one 'unit'.

In 1942 a young girl from Southampton, unable to walk, became the first person to take a motorized invalid carriage to France by air. Whole troops of Boy Scouts and cycling clubs travel together, their bicycles crossing for a mere two-and-sixpence. Nor are humans alone in benefiting from the air bridge, for hundreds of race horses, thousands of cows, bulls, sheep and pigs have been flown in specially designed pens and boxes, which slip easily in and out of the Freighter's cargo-hold when there are no cars to be carried.

To start an operation like the air ferry called for great courage and enterprise: but these virtues by themselves would not have ensured success, for customers expect first-class service and value for their money. For this reason Lympne always had its limitations. It tended to get waterlogged in bad weather, so that the heavily loaded Freighters could not operate, and, being owned by

the Ministry of Transport and Civil Aviation, every time an aircraft landed there a heavy landing fee had to be paid to the Ministry, and this naturally had to be covered by fares.

So, in 1953, Silver City announced that they intended to build their own airfield—which they proposed to call Ferryfield—at Dungeness, and that it would be opened in the summer of 1954. Remembering the years of work and fantastic sums of money poured into other airfields, many people—even those who most admired the air ferry—were inclined to shake their heads and think sadly that, for once, the company was tackling something that would prove too big for it. After early reports of the project nothing more was heard.

Then, quite suddenly and with very little ceremony, the newspapers were told that services from Ferryfield would begin, as planned, on 13th July, 1954, and that 5,000 crossings would be made between the new airfield and Le Touquet before the end of the summer season. Almost unbelievably, Richard Costain Ltd had built two 4,000 and 3,500 ft long concrete runways and an ultra-modern terminal building, complete with restaurant, Customs and other facilities, in less than six months. It was the first new civil airport opened in Britain for ten years and the first ever built by an airline. Costing only £300,000, Ferryfield is equipped with all the latest radio and radar aids for bad weather and night flying; so that Silver City are now able to operate a round-the-clock service, instead of being restricted to the hours of daylight.

But even that is not all, for they have even more spectacular plans for the future. At a time when most

airlines seem scared to talk about helicopters, because they are not yet perfect and cost a lot of money to operate, Silver City have applied for—and been granted—licences to use big helicopters on all their air ferry services. They will probably begin in a small way, by flying regular cross-Channel freight services with a single-engined helicopter. Passengers will be carried as soon as suitable twin-engined helicopters become available.

But, by 1958-9, Silver City visualize great turbo-prop-powered helicopters winging regularly across their seven 'air bridge' routes, each carrying three cars and 12 passengers in its roomy cabin. Then, indeed, they could offer a service unrivalled in the world for, although flying times would be reduced only a little, turn-round time at each end of the journey could be halved; landing fees could be reduced considerably because no airfield runways would be needed; and the helicopter's unique ability to fly slowly or even hover motionless in bad weather would improve safety and regularity throughout the year.

Once again, there are many critics who say that Silver City are far too optimistic and that helicopters are still seven or eight years away. The same people said in 1948 that the car ferry would never be cheap enough to be successful, and in 1953 that no fully-equipped airfield could be built in a year at a cost of £300,000. Already a helicopter that would meet air ferry requirements is being built by The Fairey Aviation Company, and this Rotodyne, as it is called, is due to fly in late 1956. Between them, Fairey's and Silver City may well set an example of leadership for the whole world, by proving conclusively that the helicopter is the supreme short-range transport vehicle for the future.

Chapter Eight

FLYING ZOOS

IN ABOUT 50 years time, so the rocket enthusiasts tell us, some brave young man will clamber aboard a space-ship, push a button and 'whoosh' off the face of the earth on the first attempt to fly to the Moon. If he gets there safely, it will be one of the greatest scientific achievements of all time. If he gets back again, it will be almost a miracle.

He will not, of course, be the first traveller in space. In fact, two very young travellers named Pat and Mike could already tell us quite a lot about what space flight will be like if they could talk, because they have been shot up to a height of 37 miles in an American Aerobee research rocket and landed safely again afterwards. Unfortunately, being monkeys, they can't tell us of their experiences. But cine-film showing their reactions during the trip, and recorded measurements of their heartbeats and breathing have told us something of what the space-men of tomorrow may expect when they fly beyond earth's atmosphere.

Monkeys and mice are used a lot in this sort of modern research; but it is no new idea for animals to pave the way for human flight. The very first air travellers in a Mont-

golfier hot air balloon on 19th September, 1783, were a sheep, a cock and a duck. Despite which, if you had suggested to someone in the early years of this century that it would one day be possible to travel to Australia within 24 hours, or produce moving pictures out of thin air by television, you would probably have been told, 'Yes—and pigs might fly'.

A pioneer British pilot named J. T. C. Moore-Brabazon got a bit tired of this saying in 1909, so he tied a waste-paper basket to one of the wing struts of his stick-and-string Voisin biplane, stuffed a small pig into it and promptly proved that pigs could fly! Today, as Lord Brabazon of Tara, he has the satisfaction of knowing that the practice of carrying animals in aeroplanes, which he started, has grown to such an enormous degree that every fifth passenger carried by B.O.A.C. has four legs, no legs at all or wings.

This does not mean that 14 of the 72 seats on a trans-atlantic Stratocruiser are reserved for any wealthy dogs, cats, zebras or elephants who want to visit their relatives in New York! Animal travellers have their own specially equipped aircraft, and specially trained crew members to look after their comfort and safety, just as we have stewards and stewardesses to take care of us when we fly.

What is more, they even have their own private hostel at London Airport, where they can break their journey and find food, shelter and skilled medical attention if they feel off colour. Built by the R.S.P.C.A., at a cost of £20,000, this hostel is the only one of its kind in the world, and is a most fascinating place to visit.

Almost any day you will find there a selection of dogs

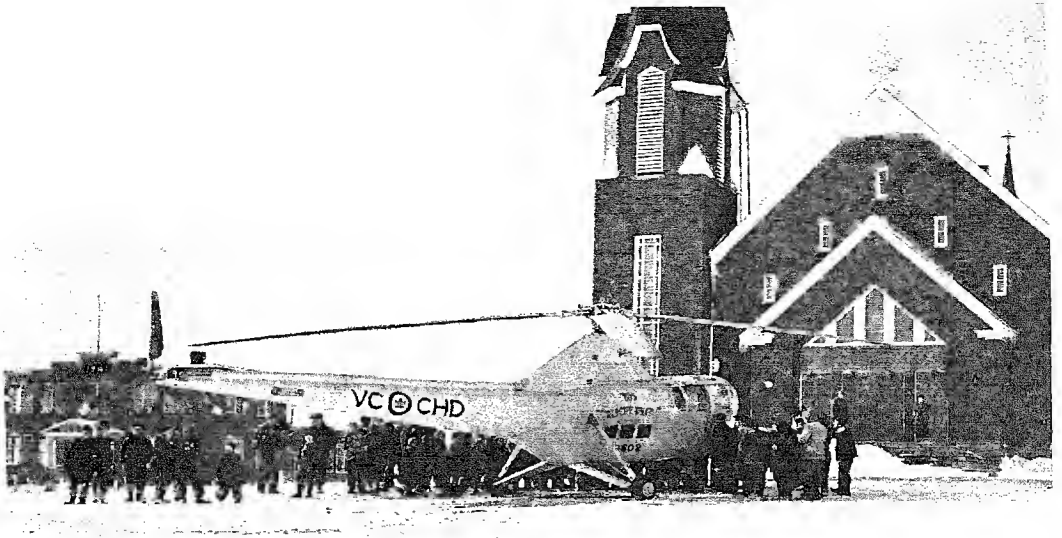
of all shapes and sizes, frisking about in wire-fenced runs that are complete with built-in 'lamp-posts'! But there are much less familiar animals than dogs to contend with on most days.

No matter what kind of guest arrives—and some pretty queer animals are carried at times—the hostel can take them in. There are huge rings set in its concrete floor, to which elephants can be tied. Stalls for horses are fitted with special quick-release fastenings, so that the animals could be got out quickly if there was a fire. A heavy wooden cage with iron bars has been occupied at various times by lion cubs, tigers and a black panther. And an incredible variety of food is available to suit the taste of everything from a cow to a cobra.

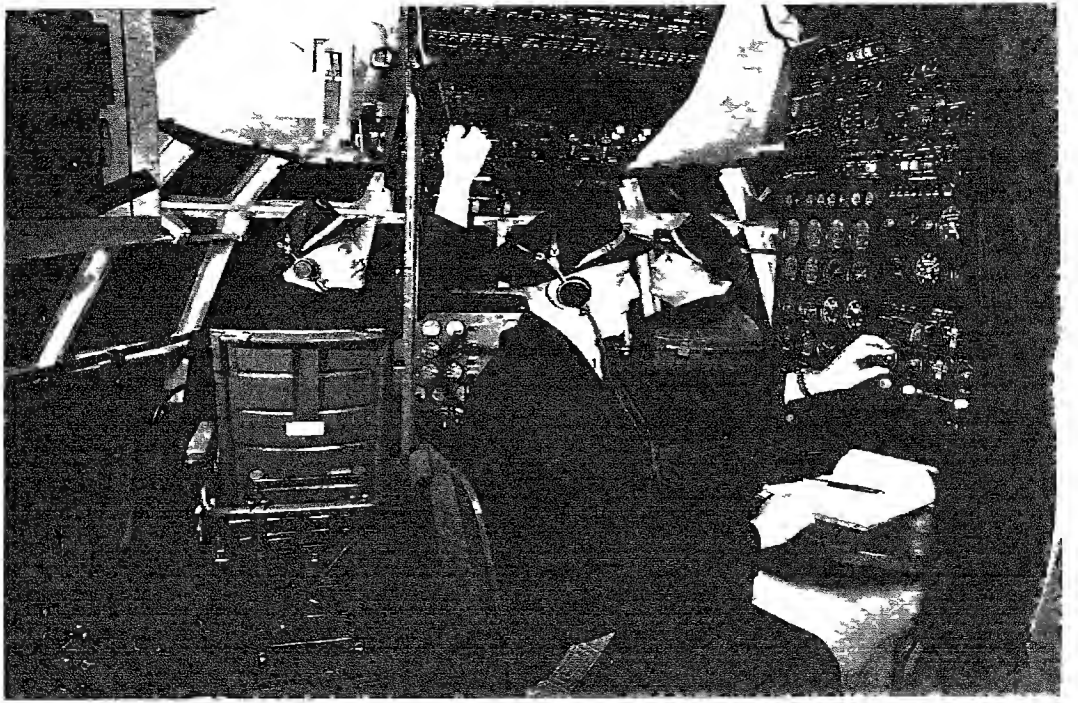
Obviously, handling such a variety of animals is no job for amateurs. The staff of the hostel are all highly skilled, and a fully qualified veterinary surgeon is available 24 hours a day to deal with emergencies. The spick and span operating theatre where he works is as well equipped as those in many real hospitals.

His services are, however, seldom required, because most animals take to air travel as eagerly as you or I. Even thoroughbred racehorses, the most highly-strung and temperamental of all creatures, cross oceans and continents regularly by air and race within a few hours of landing; whereas they might well require several weeks' rest after a long and rough sea crossing.

The famous British show jumper 'Foxhunter' is an experienced air traveller; so is the Queen's horse 'Landau'. Another horse which arrived at Ringway Airport in 1954 will be even better known to most of you, for there are few youngsters who have not been thrilled by 'Trigger',



Another life is saved as an R.C.A.F. Search and Rescue helicopter collects a small girl with a ruptured appendix from Point Sapin, New Brunswick, and carries her swiftly for an emergency operation at the R.C.A.F. Hospital, Goose Bay, Labrador.



Pilot (*left*), co-pilot (*right*) and flight engineer (*centre*) on the flight deck of a Boeing Stratocruiser air liner Behind them, and not shown in this photograph, sit the navigator and radio operator

the mount of cowboy film star Roy Rogers. 'Trigger' was, in fact, about the most valuable cargo ever flown by an airline, because he was insured for a million dollars during his flight across the Atlantic to England.

Very few animal air travellers are worth as much as that; but whether they are tiny day-old chicks or a valuable thoroughbred racehorse, they are treated with the greatest possible kindliness. Most big airlines have even produced special books telling their staff how to care for all these different, and often faddy customers. Although highly serious, the books sometimes make rather amusing reading!

Typical is that prepared by B.O.A.C., who carry about 130,000 animal passengers each year. Dealing first with special accommodation for them, it points out that mammals prefer to travel in semi-darkness, which they find restful; but that birds must be stowed facing the light or they will not eat.

The cages themselves must be 'nose and paw proof', as a loose corner or turned-up edge can quickly lead to undoing of the whole structure at the hands of a persevering bear. Similarly, wombats, squirrels, porcupines, mice and rats have to be flown in metal-lined boxes, or they would gnaw their way to freedom.

Apes require special care. They have to be given blankets to wrap themselves up during the journey, and hate travelling without a few friends. If there are no other apes on the plane, they will settle for human company as second best. Brazilian parrots and Australian gallaps, on the other hand, are much more anti-social and cannot be allowed to travel in pairs. If they did, the stronger one would probably prevent the other from feed-

ing and might even bully it continuously throughout the flight.

Few animals are as mean as that, however, and some rather surprising friendships are sometimes found. Until recently, it was difficult to keep elephants happy during a long flight. Then, one day the passenger list of an animal special included a young elephant and a white hen. Jumbo became so interested in the hen that he forgot all his first flight fears and the two became firm friends. This made the airline's freight department sit up and take notice. They tried the experiment again and it worked, the best results being obtained when the hen sat on the elephant's head! As a result, a white hen is always carried now when elephants travel by air; and everyone seems happy.

Some animals, like some humans, are fidgets; and zebras, antelopes, deer and similar beasts have to travel in boxes with walls padded to a depth of at least 12 inches, to prevent them hurting themselves. Partridges, francolins and pheasants also need padded cells, as they have a stupid habit of jumping up and down and banging their heads on the roof. So their cages usually have a piece of canvas stretched tightly across the top about two inches below the solid roof, to form a 'crash barrier'.

This is only a start, and most airlines keep a large stock of other special 'cabins', ranging from big, expensive horse boxes to burlap bags for snakes. Least troublesome of all the animals are probably the day-old chicks, which travel by the hundred thousand, packed only in cardboard boxes. They do not even require regular attention, as they need no food in the first 72 hours of their life. Crocodiles are equally easy to please, as they require

no food and remain quite happy as long as they are watered daily with a hose.

Most other animals, like human air travellers, get hungry on a long trip, and present the airlines with a few problems. Orang outangs, gorillas and chimpanzees, for example, have to be given three square meals a day of bread and butter with jam or honey, fruit and greens, backed up with lumps of sugar and pieces of cake between meals. Beasts of prey, such as lions, tigers and panthers, only need one feed a day, but it has to be a good one, with not less than 3 lb of raw meat for every 60 lb of their weight.

Drink is equally as important. In fact, B.O.A.C.'s little booklet claims that few things tend to make wild animals tame and friendly more than the right sort of drinks, adding that several types of monkey can easily be trained to drink from the spout of a watercan or bottle. This may not be the sort of behaviour one sees in the most fashionable restaurants, but the monkeys are usually gentlemen enough to form a queue and drink in turn when the attendant places the spout through the bars of their cabin.

Frogs, toads, newts and salamanders do not drink, but they must always be kept damp, otherwise they cannot breathe through their skins and quickly dry up and die. So they have to be packed in with plenty of damp white blotting paper or sponges to keep the atmosphere around them moist.

Despite all this care and kindness, animals do sometimes escape aboard aircraft; but their handlers know how to take care of little things like that. As a rule, they escape only because they think they will be safer and warmer somewhere else, and have no intention of attack-

ing any human beings they meet. But, of course, if the animal in question is a tiger or rattlesnake, it is not worthwhile taking a chance on this being true and they do need rather special treatment.

Small monkeys and young animals can usually be put back where they belong by gripping them by the neck immediately behind their heads. Martens and foxes, on the other hand, are best taken by the tail and held at arm's length whilst on their way back to their cages. Needless to say, this sort of treatment is not very popular with most animals, and if you tried it on a kangaroo, for example, he would probably try and kick you in the stomach. Ostriches and other large birds would merely do their best to peck at your eyes. But that is all part of the fun!

Nor is the life of an animal handler exciting only when his charges escape, and there is a famous story of how one of them took a husky animal of the sheep dog variety for a walk around La Guardia Airport, New York, during a refuelling stop. *En route,* it was offered a drink of water, which it proceeded to swallow in great thirsty sips. Another cargo man, who had been raised on a farm, remarked that it was the first dog he had ever seen drinking water *that* way. In fact, he had always understood that dogs and other animals lap water with their tongues, and that wolves are the only sippers in the animal kingdom. Back into his crate went Brother Wolf in double quick time, and the animal handler never did find out what its owner—an American soldier stationed in Germany—*thought* he was sending home to amuse his kiddies!!

Then there was the time when a racehorse drank so

much water at a transit stop that he had to be left behind, or his increased weight would have overloaded the aircraft.

Apart from racehorses, dogs and day-old chicks, most of the animals referred to in this chapter were destined for zoos. Our own London Zoo was, in fact, re-stocked very largely by air after the war. In a single 'flying Noah's Ark', Pan American World Airways brought across the Atlantic more than a dozen crates, containing 13 horned lizards, five gila monsters, two boa constrictors, a variety of other snakes, frogs, turtles, chameleons, sparrows, blue jays, robins, ten prairie dogs and two skunks. Zoo attendants, who handed over the animals to the airline at La Guardia Airport, told the crew that they were not sure whether the skunks had been 'de-scented', which did not make them any too popular!

B.O.A.C. contributed two firm favourites to the Zoo's collection—the West African pigmy hippopotamus 'Boac' and the black and white panda, 'Miss Lien Ho', which was a gift from the people of China to Britain. In one typical week, they carried to London two orang-outang apes from the jungle of Borneo, a honey bear from Australia, a peacock, 300 monkeys from India and a consignment of live mink from Canada, as well as Australian kangaroos and South African bees bound for Moscow Zoo.

The big advantage of sending zoo animals by air is that, compared with surface travel, if they come from a country with a cool climate on the other side of the world, they spend the fewest possible number of hours travelling through the heat of the tropics. If, on the other hand, they come from a warm climate, they can travel in

a heated aircraft and be given a warm welcome—literally —at the airport, by transferring quickly from the aircraft into a heated van, which will take them to their new home. As a result, they arrive in the finest possible condition.

There is much more that could be written about carrying animals by air, for there is hardly a single specimen that has not been flown at some time or other, and all present their own particular problems. But the biggest problem of all is the giraffe. His neck, which gave him such a flying start by enabling him to look down on almost all of his jungle friends, now keeps him firmly on the ground while they fly overhead in armchair luxury aboard 300 m.p.h. airliners. Until we have aircraft with 16 ft high cabins or sunshine roofs, he will have to remain grounded in this modern world where virtually the whole animal kingdom has wings.

Chapter Nine

OUR DAILY BREAD

TOWARDS THE END of the Korean War, in June, 1953, the United States Army carried out an interesting experiment which they called Operation Sky-way. For three days they supplied by air all the food, ammunition and equipment required by three infantry brigades of the 1st British Commonwealth Division, using only 14 comparatively small Sikorsky H-19 helicopters belonging to the 6th Transportation Company. The results were so successful that they now plan to replace nearly all their lorries with helicopters for front-line transport and supply duties in the next few years.

At first glance it seems an expensive way of doing things. An H-19 helicopter costs around £50,000 and, because of the high temperature and humidity in Korea, each carried an average of only 875 lb of cargo per flight during Operation Sky-way. But, as in the case of the Berlin Air Lift, financial cost is often the least important consideration in a military operation.

Because of their higher speed and the fact that they do not have to travel along roads marked on enemy maps, helicopters are less likely to be hit by enemy gunfire than are lorries. Similarly, their ability to fly anywhere, over

rivers when bridges have been destroyed, across mountain ranges and seas, to outposts that are cut off from surface transport, might well mean the difference between victory or surrender when the battlefield is in difficult country, as it was in Korea.

In any case, helicopters travel so much more quickly than lorries that they can make three or four times as many trips a day, and so do the work of three or four times as many lorries. And, as bigger helicopters become available, their advantages will increase, because a fleet of only ten aircraft like the Fairey Rotodyne, flown by 20 pilots, could probably replace 100 army lorries and more than 100 drivers.

Nor will such aircraft have only military usefulness, for more and more of the food we eat every day is being brought to us by air, and the proportion is certain to increase when helicopters are available for true 'door-to-door' delivery. This does not mean that your baker or milkman will hop down the road by helicopter, dropping odd loaves of bread and pints of milk at your doorstep. But a surprising variety of food will be carried by air on the first stage of its journey, from the farms or factories where it is produced.

As in the case of passenger and freight carrying, the big advantage offered by air transport is speed. So it obviously has tremendous possibilities for delivering food, because the quicker a load of meat, cheese or vegetables can be got to the shopkeepers, the fresher and more appetising it will be for their customers. The shopkeepers also benefit, because the goods can remain in stock longer before they begin to go bad, which means less wastage and higher profits. So it is hardly surprising that

food of various kinds has become one of the most regular and profitable air cargoes since the war, especially in America, where housewives are very 'vitamin conscious'.

As most of you know, many fruits are picked while they are still green; because if they were left to ripen and then sent by ship, road or rail to wholesalers and shops they would be bad by the time they arrived. Bananas, oranges, tomatoes and many other fruits are ripened artificially while on their way from where they are grown, and this obviously cannot be as good as if they had ripened in the sun.

It was Dr Stephen Larsen, director of air cargo research and professor of business administration at Wayne University, who first proved scientifically the superior vitamin-content of air-freighted food. With the co-operation of experts from U.S. Department of Agriculture, he picked four baskets of the finest nearly-ripe green tomatoes from vines at Bakersfield in California, sent them to a nearby packing plant and had them shipped in the normal way by rail from there to the city of Detroit. The journey took 11 days, after which they spent three days in tomato-ripening rooms before being considered ready for sale. Their condition was rated above average.

Two days before they were declared ready for the shops, a second batch of tomatoes was picked from the same field in California and flown to Detroit by United Air Lines. In the 12 days since the first tomatoes had been picked, the rest of the crop had ripened in the sun and, by the time this second batch reached Detroit, 24 hours after picking, it was exactly ripe enough for sale.

Samples of each consignment were then taken and

tested scientifically. The air-freighted tomatoes were found to have an average Vitamin C content of 25·45 units per 100 grammes. The railborne ones had a content of only 14·43 units. Furthermore, those which had been left to ripen in the sun were judged to be more juicy and tasty and to have better colour, aroma and texture.

Of course, the greater cost of air freighting means that customers have to pay a little more for airborne tomatoes, but there are few people who are not willing to pay an extra penny or two for the best, and Dr Larsen's experiment proved conclusively that air-freighted tomatoes *are* best.

What is good for tomatoes is equally good for most other things, especially if they are even more perishable, like fish or cheese. British importers realised this several years ago, which is why a fleet of large refrigerated lorries glides into Le Touquet Airport on the French coast every Sunday morning before breakfast, carrying loads of delicate cream cheeses. Waiting on the tarmac to meet them is a flight of Bristol Freighters.

The lorries back right up to the open nose doors of the Freighters; porters swiftly pass the small white wooden boxes of cheese into the 2,200 cubic feet freight holds, and within 30 minutes the first machines are airborne. Twenty minutes later they land in England, where a fleet of lorries is waiting to drive out to the aircraft the moment their propellers stop turning. Again no time is wasted. Each aircraft disgorges its five-ton load of cheese and within a further 30 minutes the cargo has cleared Customs and is on the road.

The first consignments to leave are those bound for Scotland; those for the Midlands follow, and the cheese

for nearby London leaves last. All is distributed within 48 hours of leaving the French factory, so quickly that none of its freshness or goodness is lost.

Most of the cheese is Gervais, imported and distributed by a Southampton firm. Air transport saves two days compared with shipping and so prolongs by two days the saleable life of the cheese, which has greatly helped sales in Scotland and the North of England. Once again, a slight increase in freight charges is more than offset by the advantages. The manufacturers and importers sell more cheese, the customer gets fresher supplies; and the airline flies its aircraft back to England with a useful cargo, when otherwise they might have to return empty.

Almost every kind of food is being carried by air as a matter of course nowadays, from the humble but most essential loaves of bread distributed to isolated holiday resorts in California by Desert Airways to the most expensive luxury food of all—caviar. In fact, the British independent airline, Skyways, carried no less than 7½ tons of the best Persian caviar in a single York aircraft from Teheran to Europe in July, 1954. Worth £75,000, four tons of it was destined for Hamburg, 1½ tons for Sweden and the remainder for London.

Many of the long strings of brown Salami sausages that can be seen in shops in the Soho quarter of London and in most large grocery stores are brought by air from France and Spain. So are the very popular button mushrooms and the bright glass containers of liqueurs, shaped like little railway trains or soldiers, seen in our 'locals' at Christmas time. Strawberries, grapes, lettuces, new potatoes and every other conceivable type of fruit and vegetable are flown regularly to England from the Conti-

nent, North Africa and the Channel Islands for our enjoyment, sometimes as much as eight tons of fruit arriving aboard a single DC-4 freighter.

A glance through the list of freight carried in a single week by British airlines gives an idea of the variety of the food cargoes—fresh salmon and reindeer meat from Stockholm to London; beef from Nantes to Lydda; grapes from Valencia to London; three tons of frozen food from Paris to Manchester; lobsters from Newcastle to Amsterdam; turkeys from Istanbul to London; yeast from Amsterdam to Lydda; chocolate and whisky from London to New York.

At the moment, the total of all this traffic is small, compared with the immense weights carried by ship, road and rail; but it has grown enormously since proper cargo-planes like the Bristol Freighter became available. When helicopters are in service, it should increase even more quickly because, by flying right into the centre of cities, it will be possible to cut out the cost in time and money of transferring cargoes from aircraft to lorry at each end of the journey.

Australia—the most air-minded country in the world—has given a lead in the use of air transport for producing more and better food, with the remarkably successful Air Beef venture, which promises to bring new prosperity to the vast area of Northern Australia known as the Kimberleys. This could be one of the richest cattle-producing areas in the world; but its development was always hamstrung by the impossibility of building roads or railways at reasonable cost. Few settlers would chance their luck there, because the only way of getting cattle to the outside world was by driving them hundreds of miles

over arduous stock routes to the coast—a journey that reduced the weight of each beast by anything up to 100 lb.

In 1949, however, a company named Air Beef Ltd was formed to try and overcome some of the problems. The principal shareholders were Australian National Airways, the MacRobertson-Miller Aviation Company and a number of local farmers, including Mr Gordon Blythe, whose property at Glenroy was chosen as centre of operations.

Briefly the idea was that farmers from all around Glenroy should bring in their cattle to the centre, where they would be slaughtered and flown as carcasses to the nearest port, at Wyndham, aboard A.N.A. freight-carrying aircraft. The distance by air from Glenroy to Wyndham is only 183 miles, compared with 300 miles by stock route or 800 miles by road. Flying time is only 75 minutes, compared with 30 days taken to drive cattle overland.

First of all an airstrip was made at Glenroy. Although 8,000 ft long, it cost only £100, being simply scraped out of the flat land. All machinery, plant and buildings for the abattoir, chilling chambers and homes for the workers were then flown into the airstrip, and assembled in time for 1,800 beasts to be slaughtered and flown to the coast in that first season.

All fears that the chilled meat might deteriorate during the 75-minute flight to Wyndham in an unrefrigerated aircraft were proved to be groundless. In fact, the experiment was so successful that in 1950 A.N.A. sent one of their new Bristol Freighters to Glenroy, to replace the Dakota used in the previous year. As in so many other parts of the world, its quick-loading facilities and ability to carry nearly six tons of meat over the short route to the coast guaranteed even greater success and, by the end of the

five-month season, making two trips a day, the Freighter had lifted well over two million pounds of beef and 155,420 lb of hides.

Helped by a Government subsidy of one penny for each pound of meat delivered to Wyndham, Air Beef began to show signs of revolutionizing the farming business in Northern Australia. Not only could the best meat be sent to the coast in perfect condition; old cattle that had been abandoned to graze until they died, because they could never have stood up to an overland drive, were brought to Glenroy and fetched about £6 each as 'small goods' meat.

In this way farmers were able to clear their old stock. But that was not all, for instead of returning empty the Freighter brought back to Glenroy supplies, equipment, mail and even a 3-ton tractor, at rock-bottom cost to the farmers, and made diversions to pick up new pedigree shorthorn bulls to improve the quality of herds in the Glenroy district. Seldom had there been a better example of how air freight can speed the development of isolated areas. Nor did it benefit only Australia, for much of the air beef was exported to Britain at a time when we were having difficulty in getting our regular supplies from the Argentine.

Since then the Air Beef scheme has become an annual operation, and more than three million pounds of meat are flown each year from Glenroy to Wyndham. Plans have been made for establishing new killing centres; but these may have to wait until bigger aircraft become available like the Blackburn Universal, with its 22-ton payload.

Meanwhile, aviation is helping the farmer in a score of other ways, so let us have a look at some of them in the next chapter.

Chapter Ten

DOWN ON THE FARM

BACK IN 1919 an American farmer hired a small plane to fly low over his fields while he lay on the wing and shook powder from a bag, to kill insect pests that were ruining his crops. Without realizing it, he was pioneering one of the most important and exciting of all the jobs that aircraft are doing today.

Latest figures show that no fewer than 7,000 aircraft are hard at work this year helping U.S. farmers to kill insect pests and weeds, plant their crops, round up cattle, fetch urgently needed spare parts for their tractors, and even to prevent frost from spoiling their acres of tomatoes. In fact, many of the farmers would just as soon be without their plough as without an aeroplane or two about the place.

Nor is America the only country where farmers are air minded. We have already described the Air Beef scheme that is bringing new life to cattle ranches in Northern Australia. In the neighbouring Dominion of New Zealand, a big fleet of light planes is equally busy spreading fertilizer over thousands of acres of wasteland, so that it can be reclaimed for growing food. In Switzerland, a helicopter is used to carry milk from pastures

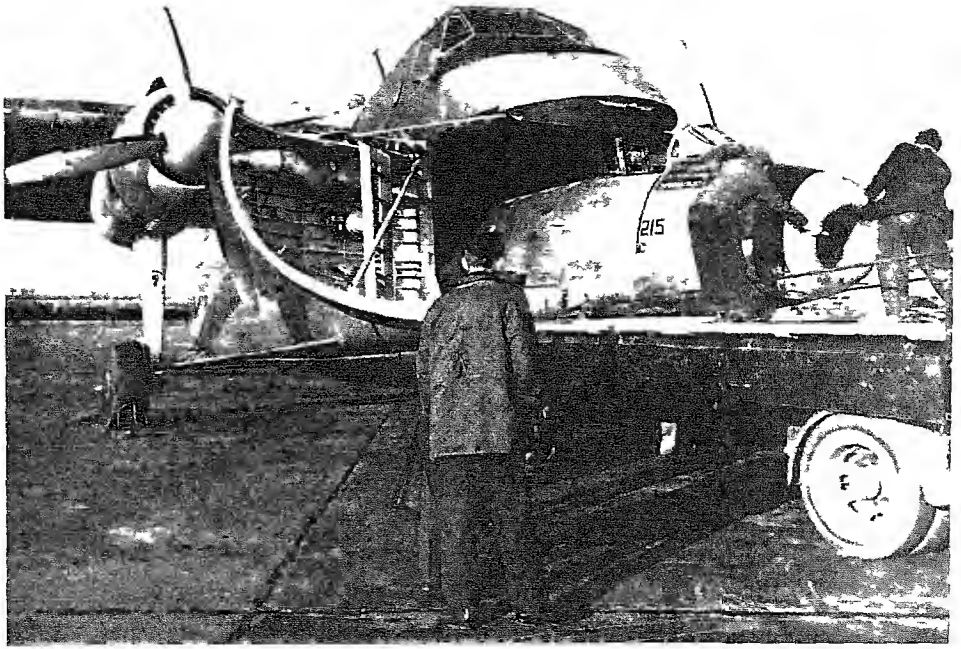
high on the mountainsides to cheese factories in the valleys. In Britain, light planes have helped to speed the harvest by artificially drying barley crops.

But the most surprising job of all is being done in Arabia, where helicopters are beginning to replace bees! Apparently there are either too few bees to fly from one date tree to another, spreading the pollen, or else they are too lazy, and the date growers have found it difficult to increase their crops. So they have now started dropping pollen experimentally over the trees from low-flying helicopters, in much the same way that other farmers spray or dust their crops with weed- and insect-killer.

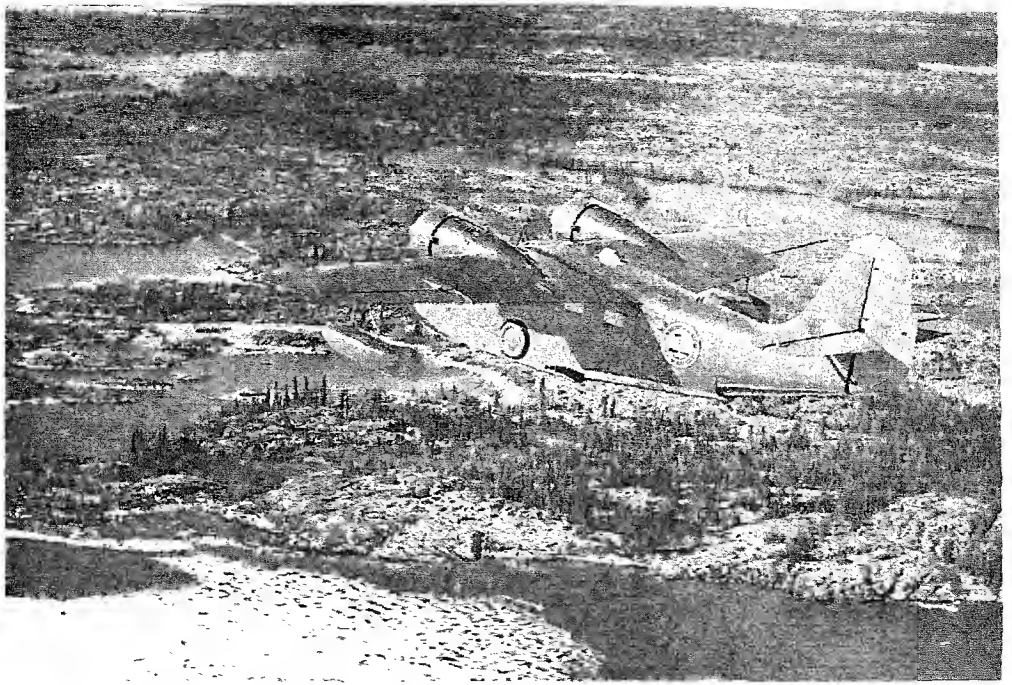
There is little need to stress the importance of all this work, because the population of the world is increasing by 68,000 every day of every year, and desperate measures are essential if we are to save millions of people from starvation in the future. The land on which to grow food is there in plenty; but it is often overgrown with weeds or too poor to produce crops, and there are usually too few people to turn it from wasteland into rich farmland.

This is where the aeroplane comes in; because it can do many jobs in a fraction of the time taken by more usual methods, and some jobs that no other machine can do, especially in rough country or remote, inaccessible areas where there are few roads.

New Zealand has set an example to the world in this respect. Vast areas of the Dominion cannot be farmed because the soil lacks all-important phosphate. For years, farmers tried spreading superphosphate 'manure' on the land to improve its quality; but it was slow work, because in most places the ground is hilly and covered with weeds and tree-stumps.



'Plane eats 'plane — a damaged R C A.F Sabre jet-fighter is loaded aboard a Bristol Freighter in France, and flown back to Britain for repair.



Grumman Goose amphibian of the U.S. Fish and Wildlife Service flying over Great Slave Lake, near Yellowknife, during a waterfowl survey.

As early as 1926, somebody suggested using aircraft for the job, and 2 cwts of fertilizer were dropped experimentally on Rongotai aerodrome in 1939. But it was not until 1947 that the R.N.Z.A.F. proved the practicability of the scheme on a large scale, by spreading 125 tons of the stuff from modified Grumman Avenger patrol-bombers. Two years later, the first private companies started work, using Tiger Moth light planes bought cheaply from the air force after the war, and the work of 'top dressing' as it is called has since grown steadily year by year.

In 1950, 5,003 tons of phosphate were spread over 48,741 acres, by a few Tiger Moths and one Auster. In 1954, more than 200,000 tons were scheduled for spreading over two million acres by a fleet of 150 Tiger Moths, five Austers, five D.H. Canada Beavers, two Cessna and three Piper Super Cub light planes, and a Bristol Freighter able to lift six tons of phosphate at a time.

Flying up and down narrow belts of countryside day after day, spreading fertilizer, probably sounds a very dull kind of existence. In fact, it is dangerous, exciting and, as a result, very well paid. Each particular job is different, bringing fresh scenery and new friends, for the pilot often lives with the farmers whose land he flies over. All demand a high degree of skill, for the aircraft have to land and take off from short and aften none-too-smooth airstrips, cleared by the farmer as near as possible to the land he wants 'dressed'. If the weather is bad or the wind above 15 mph the job has to stop, because the heavily loaded planes cannot take off if the wind is blowing across the airstrip and, anyway, the phosphate would be scattered too widely.

When operations are possible, the pilot has to take off and skirt round hills and valleys at heights which seldom exceed 300 ft, at the same time trying to pick out landmarks to guide him on his dropping runs. It is easy to make a mistake. Some pilots have stalled and crashed through trying to climb too steeply out of a short airstrip in the thin mountain air. Others have failed to notice that they were flying up a long steepish ridge and have smacked into the hillside. Several have been so intent on their job that they have flown into blind gulleys and only realized at the last moment that they are in for a lot of trouble in attempting to turn and get out again.

Careful training is, therefore essential, and would-be top dressing pilots have to put in at least 30 to 50 hours flying with an experienced pilot from good wide airstrips in fairly open country before being sent out on their own. Even then the accident rate seems, at first glance, fairly high, totalling 149 reported crashes in the three years up to 31st March, 1953; with seven pilots killed and 15 injured. But after most crashes, the pilots were able to remove the pieces of aeroplane from their hair and walk away; and only 16 aircraft were written off completely in the whole period. This is all the more remarkable when one realizes that the Tiger Moths often average 14 trips an hour, spend the nights tied down in the open in all weathers and receive the minimum of maintenance whilst in the field on a job. In fact, the accident rate averages only one crash for every 100,000 take-offs and landings, which says a lot for both the skill of the pilots and the sturdiness of the aircraft.

The Tiger Moth is not, of course, an ideal aeroplane for the job. It can carry only 540 lb of phosphate on each trip,

which means that it has to keep landing and taking off incessantly. Its 130 h.p. Gipsy engine gives it little reserve of power in an emergency; and it offers no protection for the pilot in a crash-landing.

The Canadian Beaver is a much better proposition, with its rugged structure, 1,700 lb payload and 450 h.p. Wasp Junior engine, which enables it to climb out of small airstrips from which even a lightly loaded Tiger Moth cannot fly. It is a far more expensive aircraft to buy and operate; but the higher payload makes it more economical than most of its competitors.

Nevertheless, there is little doubt that the difficulties and importance of 'top dressing' justify the design of special aircraft for the job, particularly as such machines would almost certainly be equally useful for crop spraying and dusting, to destroy insect pests and weeds. The techniques are almost identical, but crop-spraying may call for even greater piloting skill. It often has to be done from heights as low as five or six feet, to distribute the spray evenly over a crop, and this means that the pilot has to keep making steep turns at very low altitude when the field which he is spraying is a small one.

As a result, it is often best to use helicopters for crop-spraying, as they can fly very slowly and turn on a six-pence. What is more, the downwash from their rotor makes the spray 'bounce' up from the soil, coating the underside of the leaves as well as the top. But for top dressing, present day helicopters are generally too expensive, too tricky to fly in mountainous regions and able to carry too little payload.

The New Zealanders, after studying all available aircraft, decided in 1954 to place a very large order for the

new American Fletcher FU-24, which was designed especially for aerial farm work in their country. Powered by a 225 h.p. Continental engine and carrying a half-ton payload, it is probably the best attempt yet to combine in one aircraft the nine essentials for an agricultural plane. Briefly, these are:

1 Protection for the pilot who, because of the low flying involved, has no choice of landing place if engine failure or misjudgment causes a forced landing.
2 Cheap, easily repaired airframe, with as many interchangeable parts as possible, because of the risk of frequent damage.
3 Quick-loading for the fertilizer or spray, so that as little time as possible is spent on the ground. One-minute turn-rounds are by no means impossible with properly designed hoppers.
4 Sturdy, simple structure, particularly the undercarriage.
5 Quick take-off; even from grass, stones, sand or mud.
6 Good rate-of-climb for clearing obstacles after take-off and to reduce the hazards in mountainous country.
7 Very low stalling speed and first-class stability.
8 Good all-round visibility.
9 Careful design to ensure that chemicals do not get into the cockpit during loading or in flight; and to permit easy cleaning of parts which come into contact with them, particularly the rear fuselage.

Another American Company, Central Aircraft Inc, which operates a fleet of 30 spray-planes, has designed and built a strange looking gull-wing biplane called the Air Tractor, which is claimed to be the best flying farm implement in the world. Certainly it is easy to build and

to clean, and its performance and 2,500 lb payload leave little to be desired. It looks like no other aeroplane in the air; but why should it? After all, we do not expect a farm tractor to look like a family car!

There is no doubt of the value of aerial crop spraying and dusting, which is not only quicker than doing the same job by ground methods, but often cheaper, because the wheels of ground equipment inevitably damage a proportion of the crop they are trying to protect.

U.S. farmers reckon that use of aircraft adds about £1,300 million a year to their income, chiefly by destroying insect pests and weeds. Some three million acres of rangeland alone were sprayed in 1954 to kill grasshoppers, at a cost of 3/6 to 4/6 an acre. Damage caused by grasshoppers had in the past often cost the farmers 28/- an acre in terms of lost food for their cattle.

Equally good results have been achieved all over the world. Colorado beetles have been attacked in French potato fields; 36 million locusts wiped out with only 50 gallons of insecticide at a cost of £195 in Kenya; cotton jassid insects killed by spray from helicopters in the Sudan; orchards of peach, cherry and apricot trees protected in the United States; and 40 per cent of the rubber yield saved in Ceylon by destroying leaf mildew with liquid sulphur compound.

There are other uses for spray planes as well as pest control. In California and Arkansas, for example, nearly all the rice crops are sown from the air; and one of the contracts held by Central Aircraft alone covers the air seeding of 10,000 acres of wheat each year.

In North-West America, farmers are adding millions of dollars to their profits by spraying hormones over apple

and pear orchards to stop the fruit dropping before it is ripe for picking. And in England barley crops are being sprayed experimentally with what is called a 'dessicant'. This is a chemical which, if applied eight or nine days before harvesting, prevents water from moving from the roots up to the head and leaves of the grain. The dry crop can then be harvested and stored safely with no risk of rot, at about half the cost of drying it artificially in a store. What is more, the aerial spray method gives more even ripening of the grain and less likelihood of over-ripe kernels being shed.

So much for dropping from the air fertilizer, insecticide, weed-killer, seeds and dessicants. We have still covered only a few of the ways in which aviation is helping the modern farmer. In Washington state in America there is a cherry grower who harvests his fruit by helicopter. When the cherries are ripe, he simply spreads blankets under the trees and flies low over the top. Downwash from the rotor blades shakes the fruit loose and it drops onto the blankets for easy collection. He has also learned to prevent damage to the cherries by sun after rain—which makes them swell and burst—in the same way. By flying overhead, he blows the raindrops off the fruit and all is well.

Orange growers and tomato growers use helicopters to save their crops from frost damage. Knowing that there is always a warm layer of air a few feet up, even when air close to the ground is frosty, they simply hire helicopters to fly over the orchards and drive down the warmer air to prevent frost forming.

Cattlemen too use aircraft and helicopters in large numbers. Typical is the Bell Model 47 owned by the 500,000 acre Waggoner Estate Ranch in Texas, and used

for rounding up cattle for branding. By halving the round-up time and finding stray cattle quickly and easily, the little helicopter more than paid for itself in six months.

It is no longer uncommon for cowboys to swop their boots and saddle for a light plane and, although it may not be so picturesque, it is a great asset to be able to inspect the hundreds of miles of fence posts and wire around a big ranch in a few hours by air instead of making the long and tiring journey on horseback. If repairs are needed, it is usually easy to find a flat patch on which to land near the gap; and new posts and wire can be fetched quickly when necessary.

But, perhaps as much as anything, the rancher on a big estate or farmer in a remote district is grateful to the aeroplane for making his life less lonely. If he wants to see a movie once in a while, he can fly speedily to the nearest big town and be back for supper. If a member of his family is ill, the doctor is only a few minutes away instead of many hours. If his combine harvester breaks down in the middle of harvest, he can fetch a mechanic or 'spares' in a fraction of the time taken by car over rough roads. If his flocks or herds are being troubled by coyotes or eagles, he can go hunting for them with a shot gun from the cabin of his aeroplane, with good results. And if he wants the company of a few friends, his neighbours are brought nearer than ever before.

Little wonder that farmers are among the most enthusiastic of all private flyers, for to no other profession does the aeroplane offer greater benefits, for pleasure or profit.

Chapter Eleven

FOREST FIREMEN

FLYING OVER THOUSANDS of square miles of densely-wooded mountains in a light plane is no picnic, even for an experienced U.S. Forest Service pilot. With few landmarks to guide him, his life depends on his skill in controlling his bucking machine when it is tossed around like a feather by fierce wind currents, and on the continued smooth running of the tiny engine mounted a few feet forward of his cockpit.

In time, he gets to know every peak and ridge, and the occasional fir that towers above surrounding trees like a lonely sentinel. He forgets too the fear of engine failure, except when the steady drone misses a beat or splutters momentarily, so that his eyes flash quickly all around him searching for a landing space he knows cannot exist.

A few miles to one side, he watches the progress of a thunderstorm, sweeping across a range of hills. Then, suddenly, he spots something that can strike fear into the heart of a forest man quicker than anything else—a thin wisp of smoke trailing up from the trees in the wake of the storm—the unmistakable first sign of a fire which, if unchecked, could turn the whole forest into a seething, fast-moving torrent of flames and destruction.

Quick as a flash, he switches on his radio and calls up the nearest local headquarters of the Forest Service, giving the exact location of the fire, which has been caused by lightning touching off a dry tree.

Fifty years ago, such a report would probably have heralded the certain loss of hundreds of acres of valuable timber. A small group of pioneer foresters had banded together to try and stop the wastage; but the only way of reaching the fire was by pack horse or on foot. Trails were few, and the fire-fighters often had to struggle across deep canyons and up mountain divides 12,000 ft high. They had no marked routes or dependable maps. It was hard to detect fires, and many of them spread from a spark to a disaster while the smokechasers battled wearily across country for two, three or five days.

Unfortunately, courage alone cannot put out fires. The odds against these pioneers were hopeless, and in 1910 they were beaten to a standstilll by a fire which turned three million acres of timber in Montana and Idaho into a blackened wasteland, with appalling loss of life and property.

After that, trails were improved and hundreds of pack mules pressed into service. From 1926 onwards motor trucks and the first motor roads began to reduce still further the time lag between spotting and fighting a fire. But, as early as 1915, many Forest Service experts began to look to the aeroplane as the only possible means of getting to grips with a fire before it got out of hand.

Their hopes remained unfulfilled for many years; because the frail stick-and-string biplanes of 1915, with their unreliable engines, came off second best when

matched against the pounding mountain air currents. Even in 1919, when the U.S. Army Air Corps sent aircraft and experienced pilots for forest patrol duty in California, the downdraughts often proved greater than the planes' ability to climb. Pilots took tremendous risks; and many had to make forced landings amid towering trees or on cliffs and rock slides.

Not until 1926 did the aeroplane begin to win the battle. In that year the Forest Service engaged a young man named Bob Johnson to fly over the remote timberlands of Montana and Idaho, looking for fires in areas where ground look-out stations were few or non-existent. They could have found no one better, for Johnson was completely fearless, a born pilot who quickly learned every trick of the mountain winds. To him, as much as to anyone else, goes the credit for the continued steady improvement of the air-ground forest fire-fighting team that, in 28 years, has grown in scope and efficiency until it now saves millions of dollars' worth of timber every year.

It was no easy victory, and many of the pilots who made it possible paid with their lives. The fire patrol work was dangerous enough; but by 1929 it was quite obvious that aircraft could be useful in other ways too. It was a bad year for fires and one ground crew at a key point found themselves cut off from all ground transportation. To keep the flames at bay, they needed urgently more pumps and tools, but every path was blocked by fire.

More concerned with saving the timber than with his own safety, the fire chief suggested dropping the equipment by aeroplane. It was done. Axes, shovels and handpumps, wrapped in blankets, were tossed out as the little machine battered through the churning air currents at

tree-top height. Much of the equipment splintered and cracked as it hit rocks; but enough was saved to win the battle against the flames. Next year, Bob Johnson and other pioneers received contracts for regular delivery of supplies and transport of fire-fighters to posts deep inside the forest land.

The airstrips from which they operated were tiny, rough and often swept by cross-winds, being merely hacked out of the forest. But the pilots learned to manoeuvre their little single-engined Travelairs and three-engined Fords into these almost impossible spots; and where they could not land they made low, slow, bumpy and highly dangerous runs over the fire-posts and bundled the food and equipment out of the cabin at what they considered to be the right moment.

Some pretty surprising loads were dropped, including four dismantled wooden lookout houses, which could not have been delivered in any other way. The first load took up so much room in the aircraft's cabin that the crew had to climb in through the windows—but that sort of thing was all part of the job. In 1930, Bob Johnson's Flying Service alone hauled 65 tons of freight and 300 fire-control personnel. Between times, he ran an air ambulance, mail and supply service for trappers, miners and prospectors, landing on ice and snow with ski-equipped aircraft in the cold season.

By 1936 parachutes were being used to drop the equipment. Accuracy improved, breakages were reduced and the need for bulky expensive packing disappeared. Next year, the job was made even more efficient and safe when a forest pilot invented the static line, by which the parachutes are pulled out of their packs automatically as the

loads fall from the aircraft. Hot meals in insulated containers were added to the list of supplies parachuted regularly to fire-fighters.

But the most spectacular and startling development—'smoke-jumping'—was yet to come.

The idea of parachuting fire-fighters directly into a fire area was not new; but until 1939 nobody was willing to take the responsibility for sending a man crashing down among the needle-like crags, sheer precipices, ragged peaks, foaming streams and densely packed timber. Even pilots paled when they thought of dropping through the vicious unpredictable air currents over the mountains. But a handful of Forest Service smoke-jumpers decided that the possibility of saving hours of foot-slogging and of catching fires in the early stages made the dangers worth while.

Nobody had ever tried it before; so they had to start from scratch, even to the extent of designing their own protective clothing, to minimise risk of injury during landing. When dressed, they made a strange sight in their two-piece suits, stuffed with the sort of pads worn by American footballers, and with baseball helmets and wire mesh face-masks on their heads. Heavy loggers' boots, and strong braces to protect their ankles, backs and stomachs completed the 'uniform'.

First tests were made over soft, grassy meadows, high on the mountainside. Then, one day, one of the jumpers was caught by a gust of wind and slammed down into a cluster of tall trees—the sort of accident that all the men had dreaded. But after he had climbed down from the spring-like branches, the parachutist reported the most gentle landing he had ever experienced. Since then, smoke-

jumpers have always attempted to land in green trees, which they call 'feathers'.

The first actual fire jump was made on 12th July, 1940, and by the end of that year smoke-jumpers had controlled nine fires. Total cost of the service was $9,047, compared with an estimated $32,270 if the nine fires had been handled by ground crews alone.

Year by year the Forest Service grew, and in 1952 its 267 smoke-jumpers made a total of 836 jumps to deal with 267 fires. In doing so they saved the Service $1,291,200. Nor should it be forgotten that when the U.S. Army formed its first parachute troop units, it copied the training and dropping techniques of the smoke-jumpers, including their static line method of parachute opening.

To see how the smoke-jumpers work, let us go back to the start of this chapter and find out what happens when the pilot of a patrol plane reports the first sign of a forest fire.

Circling low over the trees, he radios to headquarters that five men must be sent to deal with it within an hour: otherwise it will grow into a fast-running, forest-consuming monster. It is 40 miles from the nearest road and 10 miles from the nearest trail: so smoke-jumpers are the only answer.

Within minutes, an aircraft is on the way, with five young men struggling into their protective clothing and harness inside its cabin. Over the fire, they make a quick survey of possible jumping sites, choose the most promising and fly over it at 1,500 feet.

A 36-inch diameter drift 'chute is dropped and the men check its drift carefully so that they can calculate just where they must jump to land on the chosen spot.

Once more the aircraft circles, lurching each time it crosses the mountain ridges, alternately tossing in the updraughts and dropping violently as it hits a down-current. Levelling off, it slows almost to stalling speed 200 yards to windward and 1,500 feet above the fire. In rapid succession, the five men jump out, looking mere dots against the sky and background of giant mountains. Above each of them a thin white streamer billows out, waves crazily for a moment and then opens out into a snowy umbrella.

Dangling 30 feet below his parachute canopy, each smoke-jumper begins his battle with the air currents which try to carry him away from his chosen landing site. His life and that of the forest now depend on his skill in controlling the bucking canopy. To check drift, he momentarily collapses it, and plummets downward like a rock for a few seconds. A little later, he collapses one side of the 'chute to avoid a spearpointed ridge and, dropping at 16 feet a second, crashes through the branches of a 100-foot high green tree.

His chute tangles with the top branches, jerking him to a stop 70 feet above the rocky mountainside. A second or two to get his breath back; then he quickly fastens to the tree trunk one end of a rope that was hanging at his side, releases his parachute harness and clambers to the ground.

Even before the five men have banded together, tools, rations, a radio set and other equipment will have followed them down by parachute, and within minutes they are able to get to grips with the fire. In continuous radio contact with the aircraft overhead, they can call for reinforcements and more equipment if necessary. And if the crew of the aircraft spot any fresh fires or anything they think

the smoke-jumpers should know about, they can take photographs, develop and print them in a tiny lightproof tank within 15 minutes and drop them to the fire-fighters.

In this way, the hazards are lessened. But smoke-jumping remains a dangerous game, and only perfectly fit men below 29 years of age and weighing less than 180 lb. can qualify for the work. Even then, accidents do occur. Bones are broken and jumpers have returned over mountain trails on stretchers carried by their comrades. But in thousands of jumps, nobody has ever been injured permanently or killed, and rescue by helicopter has now been introduced to speed injured men to hospital. The Forest Service has also trained for the U.S. Air Force many search and rescue specialists and para-doctors, who can be parachuted into forest areas to help survivors of crashed military or civil aircraft.

New ideas are continually being tried out. As early as 1930, first experiments were made in dropping 'water bombs' from the air on to fires. But the water wetted only a small area, and when sprayed from a hose was even less effective as it vaporised almost as soon as it left the nozzle. Since the war, more extensive tests have been made, using bomber and fighter planes, and results indicate that a concentrated attack by, say, a dozen heavy bombers, dropping large water bombs, might halt temporarily the spread of even a big fire.

Smoke-jumping too may become unnecessary when large helicopters with longer range and bigger payloads have been perfected. Such aircraft could follow lightning storms across the forests, hovering at treetop height to examine each strike. A patrolman could be lowered by rope-ladder to extinguish any smouldering spark, climb

back into the helicopter and move quickly to the next danger spot.

When a small fire had started, it could be sprayed with water or foam from the helicopter; and 'heli-firemen' could be lowered easily and accurately to deal with bigger outbreaks; being picked up again as soon as their work was finished.

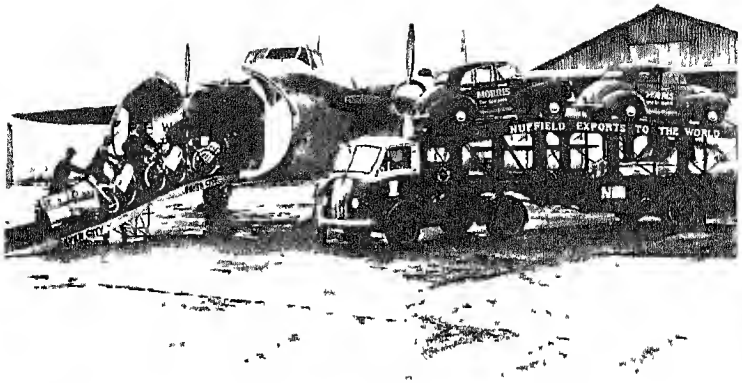
But that is a dream of the future, and the fate of tens of thousands of acres of forest remains for the present in the hands of the little band of smoke-jumpers.

However, the U.S. Forest Service is not concerned only with fire-fighting. It is also responsible for replanting burned-over areas, and has made several experimental aerial seeding operations. Chief drawbacks are that a large proportion of air-dropped seedlings fail to reach fertile soil or are eaten by rodents. But 2,500 acres of burned-out forest in Maine were re-seeded satisfactorily from the air in 1947 and 1,250 acres in Louisiana in 1948. In the first case, some 8,000 seeds per acre were sown at a cost of $3 per acre, and an average of 1,325 of them had grown into seedling trees by the end of the season.

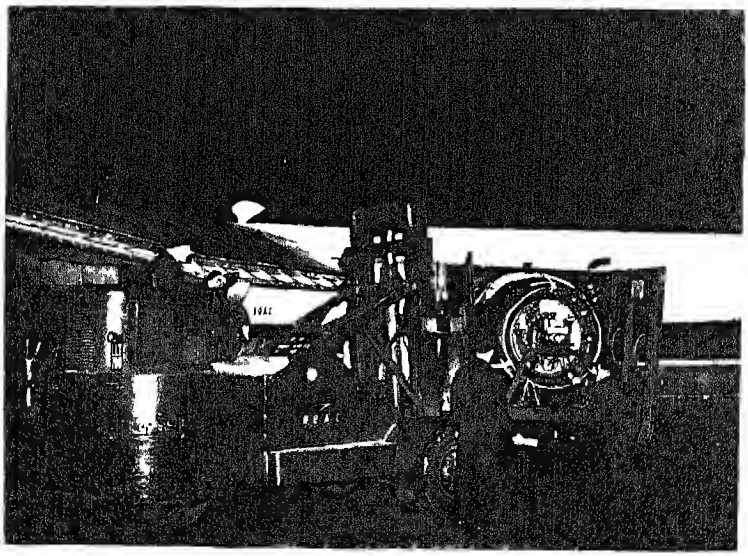
And there are other enemies to attack as well as fire. In 1953 the Forest Service sprayed from the air 371,000 acres of forest land in Oregon, 120,000 acres in Montana and 11,280 in New Mexico to destroy spruce budworms. Pine butterflies were attacked over 400 acres of Boise National Forest in Idaho; and 11,280 acres of trees infected by spittlebugs and sawflies were sprayed in the states of Wisconsin and Michigan.

Nor is the United States the only country in which forestry protection has taken wings. The biggest single spraying operation of all time is the campaign against

Trigger,' famous mount of cowboy film star Roy Rogers arrives at Prestwick Airport, Scotland by K L M flying freighter from New York



Export motor cars, motor cycles and bicycles prepare to cross the air bridge to France aboard a Superfreighter of Silver City Airways.



the budworm waged north of the border in New Brunswick, Canada.

Left unchecked, the worm would have destroyed millions of cords of pulpwood in the 1,800,000 acres of forest in the counties of Restigouche, Gloucester, Northumberland and Victoria—enough to supply the New Brunswick paper mills for several years. The only time to attack it is in June, when the worm begins to feed on the needles, buds and flowers of the trees, and in 1953 the job was concentrated into two weeks. Nearly 80 commercially-owned American and Canadian spray-planes, operating from six airstrips hacked out of the wilderness, laid nearly nine million lb of D.D.T. and oil spray over the forest. At peak periods, they were taking off at three-second intervals and landing so close together that it was not unusual to have four aircraft moving at a time on one half of a 2,500 feet gravel runway. It is too soon to claim that the battle is won; but at least the trees are still alive and a very large number of budworms are not.

Aircraft used for this work are mostly the same as for crop spraying—Stearman biplanes and Beavers—but for really big jobs Ford Tri-motors and converted Douglas B-18 bombers are often used, the latter carrying up to 1,200 gallons of spray on each flight.

Their pilots are a mixed lot, with only their qualities of courage and piloting skill in common. Most are in their thirties; but a good number are older and one pilot who plays his part in the dangerous work of forest spraying each year is a 64-year-old retired U.S. Navy Commander. Training costs them an average of nearly £200; but in a normal season they can easily earn £2,500.

Many of them do considerably better than that by

travelling down to Mexico or Central America in the winter months to do similar work, for good spray-pilots are few and far between.

Nobody will deny that their money is well earned, for forest protection, in all its aspects from fire-fighting to spraying, is saving many millions of pounds worth of precious timber every year. There is another side to the picture too, because forests are not just acre after acre of trees and vegetation, but homes for innumerable animals, some of which provide furs and skins for our clothes and sport for hunters. When a forest dies, they die too, and this also is a concern of the Forest Service.

Since 1928, the U.S. Forest Service has been busy making a nation-wide survey of the resources of America's 600 million acres of forest land, partly through the use of air photography. But as well as counting timber, it is important to keep account of wildlife in the forests and open spaces of the country. The Forest Service helps the U.S. Fish and Wildlife Service in this task also, as we shall see in the next chapter.

Chapter Twelve

SPOTTING DUCKS, BUCK AND POACHERS

WHEN LOCKHEAD AIRCRAFT designed their F-80 Shooting Star jet fighter in 1943, they could hardly have foreseen that it would one day be used for counting ducks. Yet, according to officials of the U.S. Fish and Wildlife Service, it is the most efficient duck-spotter in the world.

One of the Service's jobs is to keep count of America's fish, fur and feather wild life to ensure that hunters and anglers do not take so great a toll of any species that it begins to die out, as did the bison some years ago. One of the best ways of doing this is to photograph herds and flocks from the air; as individual birds and animals can then be counted accurately and in comfort on the photographic prints.

Unfortunately, the technique is not always successful, especially with birds. To photograph them, the aircraft has to fly quite low, and the noise of its engine as it approaches often frightens the birds, so that they fly away before the cameraman is able to get to work.

So, when the Wildlife biologists heard in 1948 that the U.S. Air Force was using a special photographic-reconnaissance version of the Shooting Star, able to take photographs at up to 600 m.p.h., they decided to see if

jet-propelled duck spotting would produce better results.

It was as good a way as any of giving pilots practice in low-altitude photography; so the U.S.A.F. agreed to co-operate and in due course Captain C. B. East and Lt C. H. Rigsby of the 12th Tactical Reconnaissance Squadron took off from March Field, California, in their RF-80 jets, and headed for the Grasslands section of the San Joaquin Valley.

In the nose of each aircraft was a Sonne S-7 camera, fully loaded with film and so designed that its shutter speed synchronized with the speed of the plane.

As they approached their target, the pilots pressed a switch that set the cameras working, dived to a height of 300 feet and roared at 400 m.p.h. over a 22-mile strip of marshes where ducks and geese were feeding, photographing every detail of the scene beneath them on a 9½ inch wide ribbon of film.

The results could hardly have been better, because the low-flying jets zoomed past the birds before they were aware of the engine roar. So, by taking sample counts of birds in relatively small areas of marshland shown on the film, the biologists were able to estimate the total waterfowl population of the district.

In the case of larger animals, the use of such shock tactics is unnecessary. Often they can be counted visually by an observer in a light plane, or photographed with an ordinary camera. Both methods are a lot easier than doing the same job on the ground, especially in rough country and where the animals are difficult or dangerous to approach. (It is not difficult to think of animals in each of these categories!)

Some of the best results have been achieved in counting

elk during the winter months, when they are concentrated on their ranges. Deer present a bigger problem because they disperse and run for cover when frightened by an aeroplane, whereas elk normally bunch and move off together. Nevertheless, aircraft are able to spot easily places where deer have been, which is a big help in keeping track of their movements.

Mountain sheep, mountain goats, moose and antelopes have also been located and counted from the air; and in a few cases an aeroplane has been used to count beaver dams and houses. Knowing how many beavers might be expected at each dam or house, this provides a rough guide to their numbers and activities in a particular district.

But biologists are not concerned only with counting wildlife. They are equally interested in its habits, particularly migration, and here again the aeroplane can be a big help. Enthusiasts like ex-test pilot Harald Penrose of the Westland Aircraft Company have spent hours observing birds in mid-air from the cockpit of aeroplanes or Autogiros, studying their wing-beats and the way they make use of air currents to sustain them in soaring flight, measuring the height and speed at which they fly, studying —and learning, for many of the greatest of aviation's pioneers started by watching and trying to copy birds.

Airmen repaid part of the debt in a very unusual manner in 1953, by giving a lift to 25 swallows that might otherwise have died in the cold weather. They were too young to join the main annual migration from Europe to Africa, and had been collected by kindly folk in Frankfurt, Germany. From there they were flown over the Alps in a Constellation airliner of South African Airways, and

released at Rome, with the worst part of their journey over. They would have been flown all the way to Africa but for the fact that it was impossible to feed them, as swallows will only eat in flight, by catching insects in their open beaks.

Another equally unusual story comes from Canada, where zoologists use helicopters to study the migratory habits of buffalo in Wood Buffalo Park, 400 miles north of Edmonton, Alberta. Flying low over the herds, they squirt paint over selected animals from a gun, after which it is comparatively easy to keep a check on the movements of the 'branded' buffalo.

Not all Wildlife Service activities are undertaken merely for the benefit of the animals. In the case of waterfowl, for example, it is important to ensure that they do not make regular mass flights outside the game reserves for the purpose of eating the crops of nearby farmers. Pilots help to prevent this by sowing from the air in the right places seeds of the birds' favourite foods, and by spraying weed-killer over useless vegetation that might otherwise overgrow the edible plants.

All this costs a lot of money; but the U.S. Government had the right idea after the war when it notified the directors of the American Fish and Wildlife Service that they could take their pick of any U.S.A.F. or U.S. Navy war-surplus aircraft that might be useful to them, without cost. Bearing in mind that an average small twin-engined amphibian costs around £25,000 new, it was the best present that the Service could have been offered, and they made the most of it by taking over no fewer than 57 aircraft. Previously, they had owned five, all single-engined.

The new machines included several twin-engined air-

craft such as the Beechcraft D-18 and Grumman Goose and Widgeon, the last two being particularly useful because, being amphibians, they can operate from lakes in reserves where there are no airstrips. Single engined aircraft ranged from 135 h.p. Piper Cubs to a 300 h.p. Stinson. In general, these types still form the basis of the fleet; with the addition of a few post-war Cessna light planes and seven Boeing YL-15 Scout observation machines, built originally for the U.S. Army.

Until recently, the Fish and Wildlife Service also owned three little Republic Seabee single-engined amphibians, which proved valuable for another, very serious, side of the Service's duties. Wherever there are game birds, fish and fur-bearing animals there are poachers; and many a law-breaker, busily putting out his nets and traps, had good reason to fear the drone of the Seabees' 215 h.p. engines.

On the east coast of America, one law enforcement officer, flying alone, caught 34 would-be duck-trappers in a single season and destroyed their equipment, which he had spotted from the air. In Louisiana, dykes and levees in the rice marshes hid quite a lot of illegal duck traps until a Seabee was sent to the area. The score: 40 poachers and 76 traps dealt with in the appropriate manner.

Often the airborne enforcement officers work in conjunction with ground teams, by scouting for law-breakers and then directing their arrest by radio. One band of 'duck-leggers' caught in California by this method pleaded guilty to killing 1,129 ducks on the three preceding days. Little wonder that many of their one-time colleagues no longer consider the game worth the risk.

As with ducks, so with fish—especially in Alaska, which is the centre for some of the world's finest salmon-fishing. About two-thirds of the Service's entire aircraft fleet is based permanently in that land and they spend a great deal of their time discouraging poachers. The amphibians are, again, ideal for keeping a watchful eye on fishermen to see that they use the proper kind of nets, and do not stray into forbidden waters. If they do, they run the risk of having their boats photographed from a patrolling Service plane, and very few of them have the temerity to plead 'not guilty' when confronted in court with that kind of evidence.

Some idea of the extent of the Service's operations in Alaska is given by the fact that in a single year its law enforcement agents have travelled as many as 239,948 miles, which is about the distance of the Moon from the Earth. Of that total, only 13 miles were by time-honoured dog teams. Aircraft, both Service and privately-owned machines under hire, were used for 134,329 miles of patrol, with an additional 300 miles by a U.S.A.F. helicopter loaned for a special trip.

Yet this is only one aspect of the Fish and Wildlife Service's work in Alaska. More than 150 tons of materials for the construction of a fish-counting weir were moved by plane from Larsen Bay to Karluk Lake on Kodiak Island for the Branch of Fish Biology. In Bristol Bay, samples of water from a number of lakes where young salmon grow were collected with a small seaplane.

Aircraft are used regularly to fly investigators between isolated canneries and fishing communities. Survey parties fly the length of streams to detect obstructions that would prevent salmon moving along them. Aerial photography

is used to count salmon below the surface of the sea and for mapping streams and shoreline.

Supplies to survey parties and wolf hunters are flown inland by seaplane or amphibian to camps on lakes and rivers. And the latest idea is to do the wolf hunting itself by air. It lacks little of the excitement of a ground chase, because the aircraft—usually Piper Cubs—have to come down very low, often in woody, snow-covered country, to give hunters a chance to pick off the wolves from the cockpit.

On one occasion, eight out of a pack of nine wolves were shot a few minutes after they were reported near a herd of caribou. Coyotes are hunted with equal success during the winter months, a total of 1,701 being killed in a single season from four Wildlife Service aircraft and a few privately-owned machines in Oregon, Idaho, Montana, North and South Dakota, Utah and Nevada. In addition, aircraft are used to fly hunters, equipment and material to and across areas inaccessible by ground transport, particularly in Alaska, where it would otherwise be completely impossible to cover effectively the huge areas infested by wolves with the limited number of trained men available.

Finally, we come back to 'flying Noah's Arks', but with a difference, for the animals carried by these aircraft are not intended as pets or zoo specimens.

The idea of transporting wild animals by air to new homes is comparatively new, but is beginning to catch on. Deer have been transplanted successfully from the mainland of the United States to the Virgin Islands. Wisconsin imported European black grouse and capercailzie from Sweden, with practically no losses. More spectacular methods have been tried out in Idaho, where beavers have

been transplanted into remote areas by dropping them by parachute in cases which spring open as soon as they touch the ground.

Nor do flying fish hold a monopoly on flying any longer, for most members of the fishy world are tough enough to withstand a dive from low altitudes without parachutes, and several barren lakes have been restocked successfully with fish dropped from aeroplanes. Indeed, there is no reason why this technique should not increase considerably the number of good, quiet fishing spots available to sportsmen over the next few years. Which shows that even Izaak Walton did not think of everything when he wrote *The Compleat Angler* three hundred years ago!

Chapter Thirteen

CAMERA IN THE CLOUDS

EARLY ON THE morning of the 17th May, 1943, a Royal Air Force Mosquito raced through the clouds over enemy-occupied Europe. Its destination—the much bombed Ruhr, heart of the German war industry and known with grim humour as 'the Happy Valley' to crews of Bomber Command, because nowhere else were there so many anti-aircraft guns waiting to fill the sky with death.

A few hours earlier, nineteen Lancaster bombers had followed the same path, flown by 133 young men whose night's work was destined to earn them the proud title of 'the Dam Busters'. Fifty-six of them did not return, and it was to measure the worth of their bravery and sacrifice that the Mosquito had set out from England, its slim wooden fuselage filled with reconnaissance cine-cameras.

Missions of this sort were among the most dangerous flown by Allied pilots. Knowing that Bomber Command's mighty offensive could only be carried on efficiently if photographs of damage were taken after every raid, German figher pilots and gunners waited patiently for the lonely, unarmed Mosquito or Spitfire that they knew would come along next day. Even if clouds hid his approach, the reconnaissance pilot had to dive beneath

them and fly straight and level for many seconds over the still-smouldering heaps of rubble to take his photographs.

Casualties were high; but the photographs the reccy planes brought back were often breath-taking, none more than those taken by the Mosquito pilot on that morning in May, 1943, after Guy Gibson and his friends had attacked the great Moehne and Eder dams.

They showed that the lakes that had lain behind the dams were empty, and 330 million tons of water were overwhelming towns and villages in the valleys of the western Ruhr. For 50 miles, coal mines were flooded and factories swept away. One of the *Luftwaffe's* most important aerodromes, and its aircraft, were under water. Roads, railways, bridges, canal banks, waterworks and power stations had disappeared. Factories that had escaped the flood were without light, power and—paradoxically—without water.

Never had a Victoria Cross been more richly earned than that which was awarded to Guy Gibson for the night's work; and seldom had a reccy plane recorded such widespread damage. But photo-reconnaissance played a great part on every battle-front in World War 2. Before the fighting started in 1939, the German General Baron von Fritsch had said that 'the next war will be won by the military organization with the most efficient photo-reconnaissance', and he was not wrong. Relying on speed and flying skill alone to elude the enemy defences, British pilots took photographs which proved that the Germans were using radar in 1940, and discovered that scientists at the secret Peenemunde research establishment were working on V.1 flying bombs and V.2 rockets long before the first ones were launched against London. They searched

out targets for our bombers and recorded the steady destruction wrought by the Anglo-American air offensive.

By comparison, peacetime air photography probably seems a tame sort of life; but it is not. If anything, it calls for even greater flying skill. The pilots who do it travel to every corner of the world, sometimes sharing their air-strips with lions or elephants. And, apart from the satisfaction of putting fresh places on the map, there is always the chance of discovering a long-lost city or a gold-mine.

This is by no means as unusual as it might sound. For example, a few years ago a London company won a contract to map a large area of Persia, much of which was barren desert. First step was to photograph the whole region very accurately from the air. Inevitably, many of the photographs showed mile after mile of nothingness, except to a highly-skilled photo-interpreter. But as they developed some of the negatives, the photographers were amazed to see a pattern of faint, regular lines beginning to show up against the desert.

They knew that there were no buildings of any sort in that district, and had been none for hundreds of years. Yet here, as if by magic, were the outlines of a palace, with courtyard and big state-rooms, surrounded by the smaller houses of friends and servants of the owner of the palace.

Surveyors had walked over the site on the ground, without seeing so much as a stone to indicate the grandeur of the buildings that the heat and searing desert winds had long crumbled to dust. But once a ditch has been dug or a bank constructed, or a wall built, the disturbance to the soil survives even a complete levelling of the site. A levelled ditch might contain more subsoil than the adjoining

bank. A levelled wall might grow nettles more easily than the surrounding undisturbed field. In each case, viewed from the air, there is sufficient difference in colour or vegetation for the outline of the long-lost ditch or wall to show up quite clearly. Hence, the ghost-like shape of the Persian palace will remain stamped on the surface of the desert for ever.

Some startling discoveries were made from the air over England as much as 30 years ago, including the avenue of Stonehenge, the so-called 'Celtic' fields and Woodhenge. Nor is air photography useful to the archaeologist only for finding features that are completely invisible on the surface. It enables us to view Stonehenge in relation to the Bronze Age burial mounds around it, or the White Horse at Uffington in relation to Uffington Castle, the early Iron Age hill fort nearby. What appears on the ground to be a jumble of banks and ditches is sorted out by the aerial camera as, perhaps, the plan of a Roman villa or deserted mediaeval village.

In Malta, photographs taken by R.A.F. aircrews during normal training flights may well prove that the island's prehistoric inhabitants invented the world's first tramway. At the request of Maltese archaeologists, whole series of photographs have been taken of early Roman forts and settlement boundaries along the nearby coast of North Africa, the ruined citadel of Rabat on Gozo Island and the deep V-shaped ruts which score Malta's rocky surface throughout the island. The latter have never been explained; but near the R.A.F's radio station at Dingli there are parallel ruts which, seen from the air, look like tramlines intersecting and crossing each other as if by a system of points. It is possible that these ruts were made by sleds,

hauled on ropes, which carried earth up the rocky slopes so that the inhabitants could make shallow kitchen gardens. In which case, the sleds were, in effect, the world's first trams, running along grooves in the surface of the ground!

But air photography in peacetime is usually more concerned with the present and the future than with the past, because it has become an essential aid to progress in almost every business from town-planning to oil-drilling.

The reason for this is that air photography is the basis for the modern method of map-making, by air survey methods. It does not replace ground survey. Indeed, a certain number of points have to be surveyed on the ground to ensure accuracy. But it saves a vast amount of time, particularly in regions of dense forest, swamp or mountains, which might be difficult or even impossible to reach by surface routes. Furthermore, even untrained eyes can easily pick out buildings, roads, rivers, trees, bridges and other features on an air photograph. The expert can learn much more; even the best place to sink a new oil well, or the number of trees of a particular type in a forest.

Let us follow the trail of a typical air survey operation, from the moment it is planned to preparation of the finished maps.

First thing that has to be decided is the scale of the maps required. Obviously, if the area is largely desert, there is little point in flying so low that every small rock can be picked out on the photographs. The higher the plane can fly, the bigger the area that will appear on each photograph and the fewer the number of photographs that will be needed. On the other hand, if the object is to

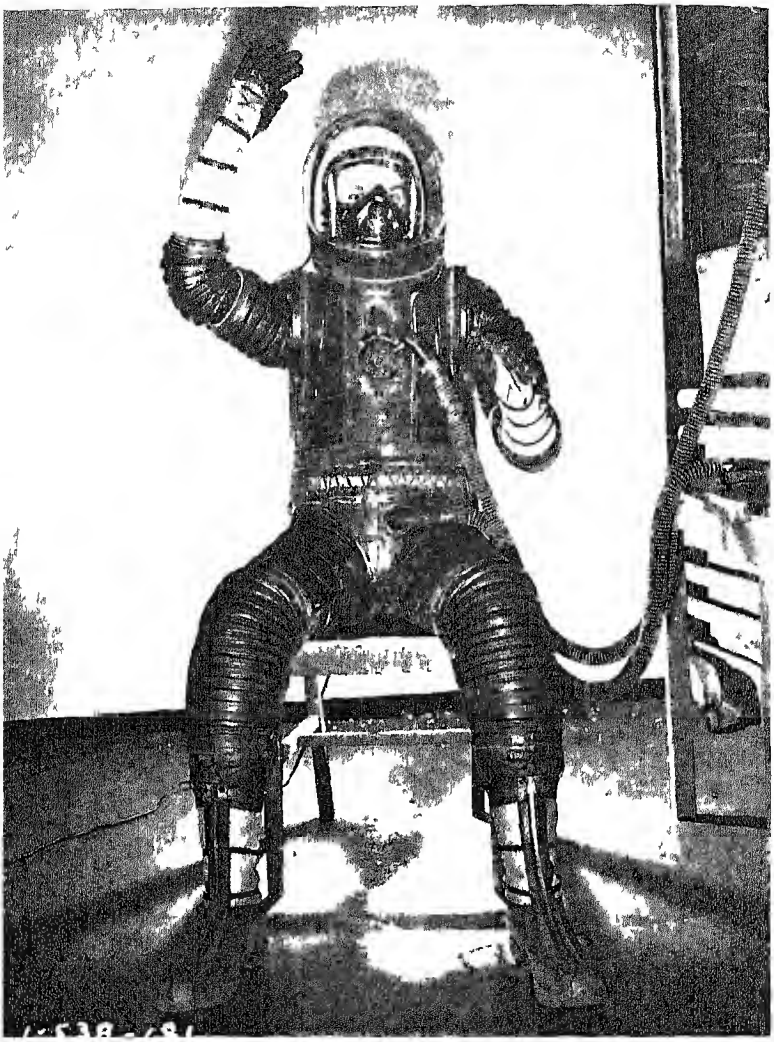
produce a large-scale map of, say, a railway marshalling yard, the aircraft will have to fly low enough to enable points and signals to be identified on the photographs. In general, the higher the aircraft flies, the cheaper will be the cost per square mile, for obvious reasons. But sometimes there is little choice. It would obviously be unwise to try and photograph an area abounding in 14,000 feet mountain peaks from an aeroplane flying at 12,000 feet!

Another thing that has to be remembered is that a camera, like our eyes, see things in perspective. As a result, if the aeroplane flies low over two adjacent flat-roofed buildings, one 200 feet high and the other 30 feet high, a man standing on the top of the tall building will look much bigger on the photograph than a man on the lower building. Similarly, only buildings immediately below the camera are seen vertically, as on a map. Those at the edge of each print appear to slope outwards, because the camera sees part of their sides. All these inaccuracies have to be eliminated before the photographs can be used for map-making.

Once details have been settled, the survey party can set out for the area to be photographed. If the job is a big one in a mountainous region, a Dakota or Survey Prince will probably be used. For smaller jobs aircraft like the Anson are quite suitable. The cameras used will be very similar to those fitted in military photo-reconnaissance planes, each carrying sufficient film for about 500 nine-inch square exposures.

Each expedition is completely self-contained, with its own pilot, air photographer, ground surveyors and an engineer to keep the aircraft in trim. Cameras, film,

Major Charles "Chuck" Yeager, of the U S A.F., is congratulated by manufacturer Larry Bell after flying at 1,650 m p h in the Bell X-1A research aircraft.



Rubber spaee suit with "goldfish bowl" helmet, designed for pilots of the U S Navy's high-flying research aircraft Above 65,000 feet altitude, a pilot's blood would boil if he were not in a pressurised cockpit or pressure suit

developing equipment and supplies are also flown out in the survey aircraft; because the area of operation may be miles from the nearest town.

On arrival at the party's base camp, the pilot first flies over the whole of the area to be photographed, to find out the best way of tackling the job. One of the main things to be decided is the position of the ground control points. These must be easily visible on the air photos, as they are usually the only features accurately surveyed and located by the surveyors, and everything that appears on the finished maps in due course will have to be positioned in relation to them. As a result, the ground surveyors often make their own control points from slabs of white-painted rock.

The actual air photography is, from the time point of view, one of the quickest parts of the job, because as much as 6,000 square miles can sometimes be photographed in a single flight at 25,000 feet with a Dakota. But it calls for great skill, because the aircraft has to be flown absolutely straight and level, at a precise height, up and down parallel tracks, with the cameras automatically making exposures at intervals that will allow each photograph to overlap the preceding one by 60 per cent. There must be a corresponding 25 per cent overlap at each side of every photograph; so that every point on the ground appears on four different negatives. This not only enables the map-makers to eliminate the 'leaning outwards' distortion already mentioned, but permits the use of 3D methods of map-making from the photographs.

Sometimes radar control is used to help the pilot keep to his precise parallel runs; but normally he has to rely on his own or his navigator's expert knowledge of navigation.

To give him more time to concentrate on this, and because it is able to correct slight changes of course quicker than a human pilot, the aircraft is normally flown by its automatic pilot during photographic runs.

The methods used to produce maps from the air photographs are too complex to explain in detail in a book concerned more with the flying side of the job. But, in brief, small glass slides are made of each pair of adjacent negatives, and these are projected in a special stereoscopic machine so that draughtsmen wearing coloured glasses see the ground as a 3D picture, from which they can trace off the land contours and other features.

When keyed against the control points fixed by the ground surveyors, the result is an extremely accurate map, produced in a fraction of the time and often at less cost than one based on old-fashioned methods. Little wonder that air photography is being used widely for the immense task of bringing up-to-date the Ordnance Survey maps of Great Britain that most of us use when motoring or cycling around the country. A ground survey might well take so long that by the time a new map appeared some of its apparent open spaces would be covered by a new town. It has happened!

Often it is not even necessary to go to the expense of making maps, because the customer can get all the information he wants from a photographic map, or mosaic, made by joining together all the photographs. Town-planners, for example, can see at a glance all the natural features and means of access to a new site. Highway engineers can study traffic bottlenecks or, in the case of a proposed new road, details such as the drainage, hilliness, type of soil and scenic qualities of the land over which it

will run, and the number of bridges and railway crossings that will be required.

By photographing work on new roads, towns, airports and other projects at regular intervals, a permanent record of progress and problems can be obtained at low cost, and may well save thousands of pounds on the next job of a similar nature. The photographs can also be used for publicity purposes to show the public how their money is being spent on vast undertakings like London Airport.

Experienced soil scientists can tell the character of an area from photographs. For instance, if abandoned farmland and clearings are covered with scrub pine, they can be fairly sure that the soil is shallow, rocky and of poor quality.

In the same way, forestry experts can learn the type, density, size and sometimes the quality of trees shown on photographs. Photogeologists can study the features of remote, rugged districts in comfort, picking out areas where valuable mineral deposits are likely, often spotting slight changes in geological formations that would be missed by even the most thorough ground prospecting.

Nor is the camera the only instrument used by air survey companies to seek out new mineral and oilfields. During the war, one of the very ingenious devices invented to detect submerged submarines worked on the principle that anything metallic must effect a change on the earth's magnetic field in its particular area. The instrument simply looked for slight changes in the magnetic field over the open seas, and if the change was caused by the metal hull of a submarine, a few depth-charges were dropped in the right place.

After the war, the same idea produced the airborne

magnetometer, which can be housed in the tail of an aeroplane, or trailed underneath on the end of a cable, to detect changes in the earth's magnetic field caused by metallic ore under the earth's surface. Goldfields have been discovered in this way in South Africa, and uranium —raw material for the atomic bomb—in several widely-separated parts of the world. Even oil has been detected, although it is not itself metallic.

So, air photography, perfected in war, is helping to plan and develop a better world in peace. It has also brought us views of our Earth such as no man has ever seen with his own eyes, for cine-cameras have travelled to heights of 57 miles in U.S. research rockets, taking photographs of 2,700-mile stretches of territory that show clearly the curvature of the Earth. It is only a start, for rocketry and space flight are still in their infancy. But who knows what photographs may not be brought to us one day when rockets are launched into the vast emptiness of space, towards the Moon, Mars, Venus and the other more distant worlds of our Solar System?

Chapter Fourteen

FLYING DOCTORS

THERE COULD BE little greater contrast in aviation than between the super-complexity of space travel, and the humanity of the Australian Royal Flying Doctor Service. The one will demand the combined skill and immense resources of a score of sciences: the other depends on a few £100 radio transmitters and a small fleet of low-powered aeroplanes, backed up by the faith and devotion to duty of a handful of quite ordinary, everyday folk.

Indeed, the idea of a flying doctor service, able to spread a mantle of safety over the vast Australian inland, started as the dream of one man—the Rev. Dr John Flynn. He began, in 1911, as a humble padre with the Presbyterian Church's Home Mission Committee, which became later the Australian Inland Mission and still does splendid work running hospitals in places too small for a regular State hospital.

Travelling for weeks over interminable distances, without communications and often without roads, he saw a vast and apparently insuperable problem. In a continent as large as the United States, half of the land was empty and neglected because it was so isolated. His own concern

was the Never Never—1½ million square miles of little rainfall where farms were the biggest in the world and neighbours seldom close enough for even telephone contact. People lived there under the shadow of disaster; because in the case of a broken leg, appendicitis or pneumonia, death could come far quicker than any doctor.

Radio and aviation were new and often unreliable sciences at that time. Yet John Flynn saw in them the answer to the problem of Australia's inland, if only radio sets could be made simple and efficient enough to bridge the immense distances between families, and if aeroplanes could be used to fly medical aid to them in an emergency.

Year after year, he campaigned to gain support for the scheme, and in 1926 the first half of his dream came true when an obscure radio experimenter in Adelaide, named Alfred Traeger, invented a portable transmitter-receiver, so low powered that its electrical generator could be driven by a pair of bicycle pedals. In the following year a D.H. 50 aircraft and crew were hired from the famous Qantas airline, and a doctor was appointed to attend urgent medical and accident cases and to supervise the movement of patients to hospital when necessary. The Flying Doctor Service was an established fact.

Since then it has never looked back, and today the Service operates from 16 bases scattered over a vast area. More than 1,000 farms, many of them 400 miles from the nearest doctor, can call for help in a matter of hours by pedal radio, and each has its own standardized medical chest to permit first aid treatment until the doctor arrives.

Never has any single development brought more comfort to remote homes, for the radios play a far bigger part in the life of the families in the inland than just ring-

ing the flying doctor's surgery bell. The best way of discovering how is to take an imaginary trip to the Service's base near Broken Hill in New South Wales to see how it all works.

The base is actually six miles from the town, in flat, arid country; and does not get a lot of visitors. So the operators still recall with pride that Her Majesty the Queen chose their little station from which to broadcast a tribute to the Flying Doctor Service during her Commonwealth Tour, on 18th March, 1954. Later, the Service was granted the prefix 'Royal'.

Today, the broadcasts are more commonplace, but never lacking in excitement or interest, for one never knows what news the next message may bring. Each base listens in for Flying Doctor calls twice a day at regular times, and during these periods no other messages of any sort may be broadcast over the radio network. Inside the base at Broken Hill, and by loudspeakers in hundreds of homes there is silence as the time approaches, for this doctor has few secrets.

Zero hour.

The operator at Broken Hill depresses the key of his transmitter.

'Anyone wanting the Flying Doctor come in please'.

The hum dies in the transmitter. Now receiving. A moment's silence. Then a woman's voice, its anxiety noticeable even through the crackle from the amplifier:

'Eight V.T. The Veldt. Good afternoon, Mr Baseden, I have a call. Can you hear me? Over'.

'Come in Eight V.T.'.

Seconds later, the doctor learns that little Judith Barlow is ill. He knows her. In fact, there are few people in his

'practice' that he does not know, although it covers more than 280,000 square miles of dry sheep country.

The child's symptoms are described—a fever—and the doctor prescribes treatment, giving the precise quantities to be used of the numbered contents of the standard medical chest.

He repeats his instructions carefully, and asks Mrs Barlow to read them back, for there must be no mistake.

'Correct. Go ahead with treatment, but I must have a look at Judith. What's the weather like your way? Over'.

'We're in the middle of a dust storm, Doctor. Over'.

'Too bad. Anyway it's a bit late. But I'll be over tomorrow morning about ten—dust, weather and emergencies permitting. Anything else? Over'.

'All OK Doctor. All OK. Thanks so much. We'll have a nice cup of tea ready . . .'

There are no more medical calls, so the air is clear for second priority business—radio telegrams. These average 2,300 a month and, at 1½d a word, are an important source of revenue to the Service. Covering an incredibly wide variety of subjects, they give a good cross-section of life in the lonely inland.

Clifton Hills orders a new stub axle for a Studebaker Dictator. Wompah advises Adelaide agents that a mob of cattle has just passed through and is travelling well. Whyjonta sends an order for 2½ inch piping and a 6 inch bore casing for an all-important artesian well. A stockman lays a bet with a Sydney bookmaker.

Incoming telegrams come next. Then the session is thrown open for private calls—an invaluable comfort to the womenfolk, many of whom see no neighbours for weeks or months. So, the Royal Flying Doctor Service has

banished the twin enemies of the inland—loneliness and fear.

Next morning, a three-engined Drover transport—a rugged Australian built machine with no 'frills' like a retractable undercarriage to go wrong—takes off from Broken Hill, heading for the farm called The Veldt. Its pilot knows every inch of the flat, uninteresting land, mottled grey and red, with stunted trees and low scrub, except where trees line dry water courses. But he never relaxes. In this country, it is said that if two mosquitoes sneeze you get a whirlwind—a swishing column of dust that can turn a plane on its back in a fraction of a second.

All goes well, and The Veldt is almost in sight when the pilot beckons urgently to the doctor to put on the earphones that link the aircraft with its base. An emergency call—'stockman Jack Scott thrown by his horse and rolled on. Crushed chest'.

After a hurried consultation, the doctor decides to land first at The Veldt, as planned, and then fly on to the injured man some 30 miles beyond. The hospital at Wilcannia is asked by radio to be ready for an emergency operation.

At The Veldt, the doctor's quick but thorough examination of Judith Barlow confirms his original diagnosis. She is doing well; but the promised cup of tea will have to wait until next time . . . Within twenty minutes, the injured stockman is on a stretcher inside the Drover. An hour later he is in hospital, at the first stage of the road to recovery.

Just two incidents from the casebook of the Flying Doctor. Two, out of more than 1,000 mercy flights made every year, covering almost 300,000 miles. Financially, it

is a co-operative effort, which is right, for everyone benefits. A full year's operation fom the Broken Hill base alone costs around £11,000, of which £3,050 might come from Government subsidies and £2,700 from direct subsidies. Add on another £1,000 received for telegrams; and the rest has to be raised by the board of the Service, its helpers and the families in the 'practice'. Contributions range from £5 a year for graziers with up to 3,000 sheep or 500 head of cattle, to £20 a year for more than 17,000 sheep or 2,830 cattle. Fees also help to a certain extent; but there is never any thought of ability to pay when a call is received, for the Flying Doctor is there to comfort and heal all, irrespective of creed, colour or position, rich or poor alike.

There is nothing like the Australian Royal Flying Doctor Service anywhere else in the world. But there are many other ways in which aviation is helping to combat sickness and suffering. In several places, doctors use their own light planes to call on patients in isolated districts, a typical example—again from Australia—being Dr Geoffrey Young, of Forbes, New South Wales.

When the Murray and Murrumbidgee rivers overflowed in 1952, causing £10 million worth of damage, he got out his little Auster Adventurer light plane and made a 200 mile reconnaissance of the flooded area before breakfast, helping other pilots to check every home in a strip 50 miles long by 20 miles wide. When he spotted distress signals he called up a rescue helicopter by radio, then returned home to load up with two heavy oxygen cylinders for the hospital at nearby Camp Hill and urgently needed food for the marooned people of Gooloogong.

It was only a start. Realizing that the flood waters

would soon engulf the little township of Bedgerebong, he flew to warn the inhabitants, landing in a spot that seemed big enough only for a helicopter. After telling the people of the danger, he offered to fly women and children to safety; but nobody wanted to go. Finally, one woman volunteered and he carried her ten miles over the swirling floods to his own property. By the time he returned to Bedgerebong, 17 other women and children had decided to accept his offer. Soon after he had finished his ferry flights, the water swept over the town and the rest of the people fled to the hills.

More 'bread-bombing' missions followed: then the biggest test of all.

Hearing that there was a sick child among 98 people marooned in two houses on the Jemalong Mountain, he skimmed over high trees and between others to make an 'impossible' landing on the steep mountainside. The little boy—only 12 months old—was very ill, so Dr Young put him in the plane and took off, missing the tree tops by inches. Back at Forbes the airfield was cut off, so he landed in a street. Within minutes he had taken the child into the local hospital, operated on him himself and yet another life was saved.

Again, as in so many other ways, the aeroplane had achieved what no other vehicle could even attempt, overcoming the natural barriers of flood and mountain, saving time where every second was precious.

Much the same story can be told of the disastrous floods in Holland early in 1954, when many lives were saved by the timely arrival of helicopters. But nowhere have these fragile-looking machines proved their value more than during the war in Korea, where they lifted some

22,000 wounded soldiers from combat areas and flew them back to hospitals behind the lines.

One story is told of a Sea Fury fighter pilot of the Royal Navy who was badly injured in a crash-landing in 'no man's land'. Other members of his squadron radioed for help, meanwhile keeping enemy patrols at bay with their cannons.

Just as their fuel began to get dangerously low, along came a U.S. Army helicopter, escorted by a formation of rocket-firing jet fighters, which took over from the Sea Furies. The helicopter landed by the crashed machine; but as soon as the doctor left its cockpit he came under fire from a nearby Chinese position. Without batting an eyelid, he grabbed a tommy-gun and, with the helicopter pilot, put paid to the opposition before lifting the badly injured Sea Fury pilot on to a stretcher and flying him back to safety.

Because of such gallant exploits, only a small percentage of the United Nations soldiers wounded in Korea died. The majority who were fit to do so were flown to the United States, 83 at a time, in big C-97 transports, sister ships to the Stratocruisers that fly B.O.A.C.'s luxury *Monarch* service between Britain and America. Never before had an air ambulance service been operated on such a scale; and never had the benefits been more apparent.

But there were plenty of busy air ambulance services long before the Korean War started. For years the inhabitants of the Scottish islands have relied on aircraft as much as the people in the Australian inland to speed them for skilled medical care when they are sick or injured.

Started in 1933 by Midland and Scottish Air Ferries

and now run by B.E.A., the Air Ambulance Service has grown from 30 to over 300 cases a year. They range from a child who drank a mixture of white paint and paraffin oil, in mistake for milk, to a man who became entangled in a harvesting machine. On one occasion, the stork flew faster than the Rapide biplane then used on the Service, and the place of birth of a very new baby was recorded as '1,000 ft over Renfrew Airport'.

The service is available 24 hours a day for the people of the Hebrides, Orkneys, and Campbeltown, and the four-engined Heron aircraft which replaced Rapides in 1955, being fairly light, land and take off from the islands' long sandy beaches. In addition to a crew of three, they normally carry a nurse to look after the patient.

As in Korea and Australia, it was found long ago that even the most seriously ill persons travel well, comforted perhaps by the thought that every minute is bringing them two miles nearer to expert care and attention.

People with broken backs have been carried quite successfully on stretchers mounted outside the cabins of helicopters; and there have been several cases of patients with infantile paralysis being flown long distances inside 'artificial lungs'. At other times, these pieces of equipment have been carried by air to people whose lives depended on their speedy arrival.

Supplies of drugs, vaccines and blood for transfusions have been flown on innumerable occasions to areas stricken by epidemics, earthquakes and other disasters. In 1952, for example, there was a violent outbreak of malaria in the Murray Islands, to the north-east of Queensland. Blood from Brisbane was flown to Thursday Island aboard an aircraft of Australian National Airways, and

there transferred to R.A.A.F. Lincolns, which dropped it to the islanders by parachute.

All these stories emphasize the age-old truth that two things are essential for the cure of any serious illness—medicine and time. The miracles of modern chemistry and surgery are supplying the medicine: air transport is giving every day that all-important extra bit of time.

Chapter Fifteen

SIGNALS FROM SPACE

OVER KOREA, DURING the bitter fighting of 1952, a U.S. Navy Skyraider attack bomber from the aircraft carrier *Boxer* droned steadily towards the enemy lines. Inside its dimly-lit fuselage a radar operator sat with his eyes glued to a television screen. His fingers moved nimbly from knob to knob on a radio control panel beside it.

On the TV screen was a slowly-moving picture of the ground. In the distance appeared a bridge. As it grew larger, the radar operator sat more erect. His fingers moved the controls with more urgency. The bridge got bigger and bigger . . . so big that it filled the screen . . . then bigger still and . . . suddenly . . . a quick flash and the screen went dead.

The Skyraider banked steeply away from the anti-aircraft guns that began to pepper the sky around it. Below, amid the debris of what had been a bridge, was the tangled wreckage of a Hellcat fighter plane. But this was no suicide mission. The Hellcat, with a 2,000 lb bomb slung beneath it, had been flown under radio control from the Skyraider, and guided into its target with the aid of a television 'eye' which it carried. It was one more example

of the way in which radio, television and aircraft designers and scientists are working together.

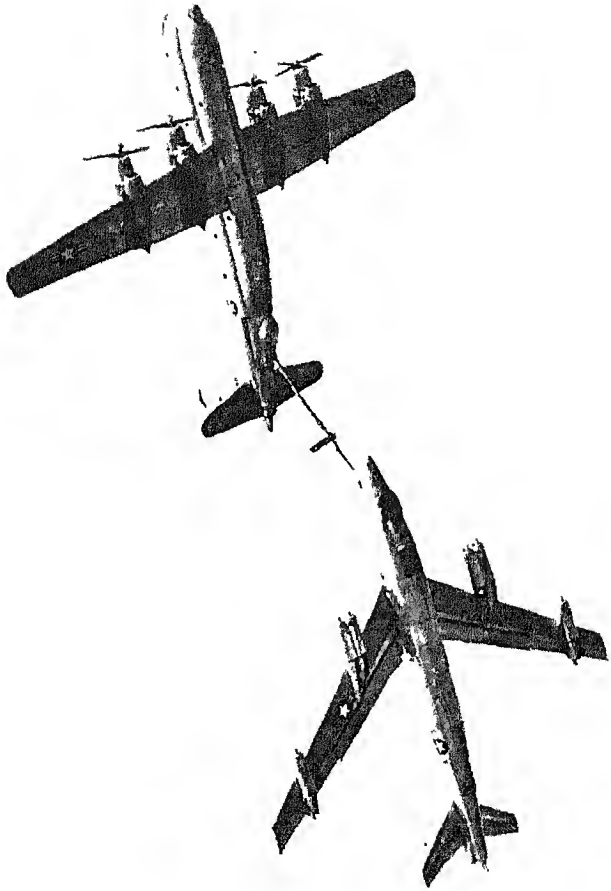
Fortunately, not all their inventions are for destruction, and aviation may eventually ensure for all of us a great deal more enjoyment from our TV sets at home. The reason for this stems from the fact that nature was not very kind to TV enthusiasts.

TV waves, like radio waves, travel in straight lines from the transmitting station and do not follow the curvature of the earth. With considerable foresight, nature provided two layers of ionized air—the Heaviside layer at a height of 70 miles above the earth and the Appleton layer at 140 miles. Radio waves—but *not* TV or radar waves—bounce back towards the earth when they strike these layers.

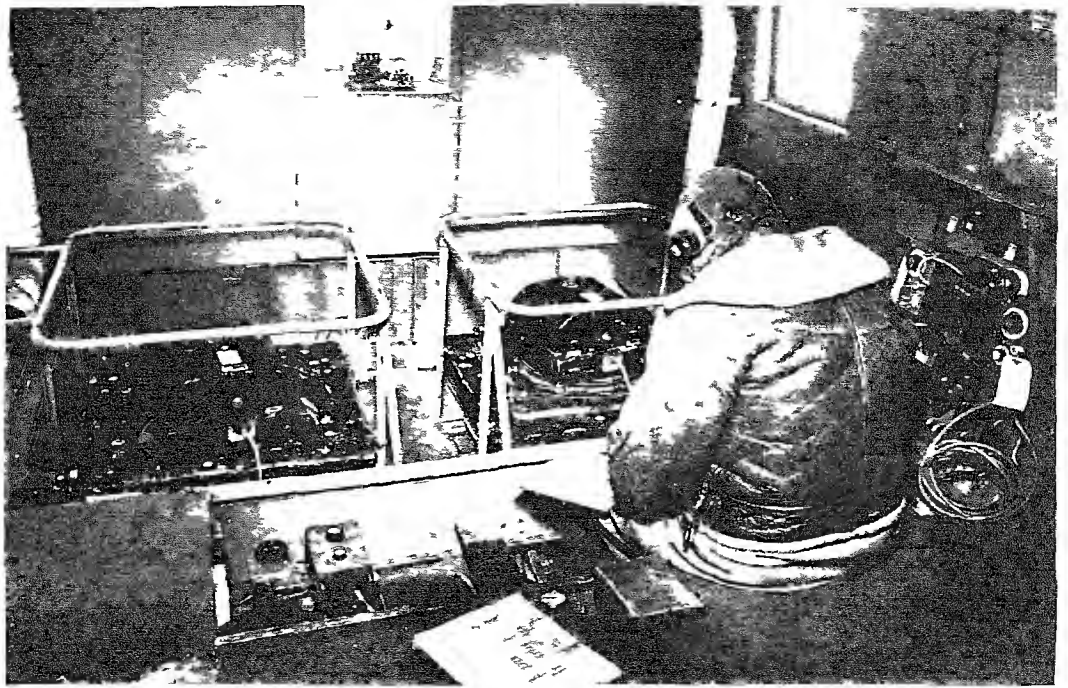
Because of this, you can quite easily pick up radio programmes from America or Australia in your home. But unless you live quite close to a TV station you will not be able to receive its transmissions, because you will be 'over the horizon', below the 'straight-line' vision waves.

This explains why TV transmitting aerials, like the B.B.C. one at Sutton Coldfield, are often 750 ft high. The taller they are, the further their programmes will reach. But it still requires quite a lot of transmitters to cover an area as small as the British Isles.

The Westinghouse Electric Corporation of America found an answer to the problem soon after the last war, and in 1949 televiewers in the States of Ohio, West Virginia, Western Pennsylvania, Maryland, Virginia, New York and up into Ontario, Canada, were able to watch a baseball game played in Boston, Massachussetts, and relayed by a single station designated W10XWB. On



Ability to refuel in flight from Stratofreighter tankers gives the swept-wing RB-47E Stratojet virtually unlimited range. Here fuel is transferred through a Boeing-developed "flying boom" guided into a socket in the nose of the receiving aircraft from the blister under the Stratofreighter's tail.



Mapping from the air — two Williamson Eagle IX cameras installed in a Dakota of the Air Survey Company Special engines camera heating and oxygen for the crew enable this aircraft to photograph the ground from heights of up to 27 000 feet

other occasions, programmes were received in 270 towns throughout ten States, all at the same time.

If you took the trouble to do some complicated calculations, you would discover that an aerial mast five miles high would be needed to relay a programme over that sort of area. And that is just what was done!

It sounds like an awful lot of mast. Actually, it was not. The mast itself measured only 25 ft long: the other 26,375 ft were provided by a converted Superfortress bomber circling at a height of five miles, with the aerial mast projecting down below its fuselage. The result was a sort of mobile Heaviside Layer, which picked up the TV broadcast from Boston and 'bounced' (or relayed) it back to earth over a very wide area—as far as the horizon in every direction. Furthermore, an aircraft fitted with this equipment—called Stratovision—can pick up and relay several programmes at the same time, if required.

In more detail, what happens is that programmes from ground stations are received through an eight foot aerial mounted atop the aircraft's fin. This aerial is fitted with several rings, each designed to receive a programme on a different frequency.

The signal is carried from there to a specially designed cabin which houses receiving and transmitting equipment, plus the four or five man crew required to keep the station on the air. From its control panel, the signal is sent to the broadcast aerial projecting under the plane's fuselage.

Like the receiving aerial, this 25 ft streamlined mast—which retracts for landing—has a number of rings, each carrying a different programme. A single aircraft can thus do the work of nine broadcasting stations at the same

time, sending out enough different shows to satisfy every type of viewer.

Obviously, flying an aircraft round and round in lazy circles at 26,000 ft, so that more and more people can watch Muffin the Mule, is no job for a pilot who wants to see the world; but it could be the means of bringing television quickly to people who would otherwise have to wait years until 750 ft masts were built on the ground. Also, of course, a flying relay station is much less of a hazard to other airmen than a collection of very high masts dotted all over the country.

Not much has been heard of Stratovision since 1950; and it may be that the problems and hazards of flying in all weathers to provide a 24 hr service are too great to make the idea practicable on a commercial basis. But the basic idea is sound; and may well be followed up in a few years time, when space flight begins to grow from science fiction to an established fact.

We read a lot about the wonderful space-stations that rocket scientists plan to build hundreds of miles above the earth—artificial moons that will encircle our world for ever and provide a first stepping stone for space flight to the Moon and planets.

Often these space-stations are portrayed as launching platforms for guided missiles, from which anybody with a stock of rocket propelled atomic bombs could have the whole world at his mercy. Fortunately, this is little more than a nightmare thought; because by the time anyone has found out how to build and launch such a space-station, it is equally certain that someone else will have designed a rocket able to shoot it down.

In any case, it is to be hoped that by the time we are

clever enough to build space-stations, we shall also be intelligent enough to use them for peaceful purposes, for there are many ways in which they could be of immense value to the whole of mankind.

As hospitals for people with heart trouble, they would be beyond compare because, in the virtual absence of the force of gravity, their heart would have to work much less hard to pump the blood around their body.

Astronomers too, would benefit enormously. At the moment they are tantalized by the thought that light which has often taken many millions of years to travel through space from a distant star, is distorted and reduced to a fraction of its real power during the final split seconds of its journey, by our atmosphere. Put their telescopes in space, beyond the atmosphere, and they will learn more of the mysteries and wonders of the universe in a week than in a hundred years from observatories on earth.

Scientists, chemists, engineers, from a score of sciences, would give their right arm to be able to work in the vacuum of space, unhampered by gravity. And, to ordinary men and women all over the world, space-stations could bring a completely new standard of international television services.

Nor need this particular benefit be delayed until the great, complex, manned space-stations, so beloved of the science fiction writers, are wheeling their way through space.

The first ones need be little more than very powerful, pilotless, research rockets able to climb fast enough and far enough to enter an orbit, or circular flight path, a few hundred miles above earth's surface. This is not the place to describe how, because the whole subject of space-flight

is covered fully in another book in this series.* Suffiee it to say that the trick is to get the speed of the roeket exactly right, so that when it flattens out the centrifugal force trying to fling it further out into spaee will exactly balance the pull of gravity trying to make it fall back to earth. Once that balance is achieved in space, where there is no atmosphere to slow down the rocket, it will eontinue its orbital flight even after its fuel is exhausted—just as the Moon continues to encircle us in spaee, without being rocket propelled!

As soon as it enters its orbit things will begin to happen to the roeket's shape. A bowl-shaped refleetor will spring out on one side to catch the sun's rays and use their heat energy to drive electrical generators. The eleetrieity produced will provide power for television cameras and delicate instruments inside the rocket which will measure such things as the intensity of cosmic rays. The view picked up by the TV cameras and the measurements will be transmitted back to earth through aerials that will sprout from the rocket in all directions.

For the first time we shall be able to view the surface of our world as a gigantic map, while the rocket flashes over oceans and continents, towns, rivers and mountains. And who knows what wonderful new discoveries might be made in space? But the real value of space-stations—or, to give them their correct name, earth satellite vehieles—to the average man and woman will be in their ability to improve our present TV system.

It is easy enough to see why; beeause the satellites could pick up TV broadcasts from earth in exactly the same way as the Stratovision Superfortress of 1949, and

* *The Adventure of Space Travel* by G. V. E. Thompson.

'bounce' them back to earth. From an altitude of 22,500 miles, only three of them would be needed to bring every spot on earth within range of TV stations in Manchester, Melbourne, Minsk, Miami, or anywhere else.

That, of course, is a dream of the future—perhaps the not too distant future, for rockets have already climbed to a height of 250 miles and the U.S. Government has announced its intention to launch very simple satellites into space within the next few years. Also, as we have seen, television has been used to guide pilotless aircraft and missiles to their targets.

Meanwhile, the U.S. Air Force and Navy is using a principle very similar to Stratovision to improve the air defences of U.S. cities and ships of the U.S. Navy.

Television is, of course, just a development of radar, and military radar presents much the same problems as TV. Unless a radar set is provided with a very tall aerial mast, on high ground, it has short range. Even then it often cannot detect really low-flying aeroplanes until they are almost on top of it.

The snag is that radar waves travel in straight lines and will not follow the curvature of the earth. So anything below the horizon is hidden from their searching eye. The solution, once more, is to put the aerial itself high in the air, on an aircraft, and this is just what has been done with the Super Constellation flying radar stations used by the U.S. Air Force and Navy.

Developed from the famous Super Constellation air liner, they present a fantastic appearance, with aerials and search 'scanners' for their six tons of radar equipment bulging from their fuselage in all directions. Protruding from the top is an 8 ft high structure like the dorsal fin

of a sailfish, which houses height-finding radar. Mushrooming from the bottom of the fusclage is a gigantic bowl-shaped radome, which is probably the largest plastic part ever built.

Powered by four 3,250 h.p. engines and equipped to fly for many hours at a height of 25,000 ft or more, these big machines could detect approaching enemy aircraft or ships when they were still many miles away—well beyond the range of radar on the ground. In an atomic age, their early warning of danger could mean the difference between life or death for a city of a million people, or for a precious convoy of supply ships and their naval escort.

Nor is that the limit of radar's usefulness in peace and war. Radar altimeters (which measure the time taken for a radar signal to travel from the plane and bounce back again from the ground) are helping the pilot to avoid the danger of flying into high ground in conditions of poor visibility. Radar gunsights and radar ranging make it almost impossible for a fighter pilot to miss his target. Cloud and collision-warning radar in the nose of our air liners enables their pilots to fly around storms and give passengers a smoother ride. And, of course, radar navigation aids make it almost impossible for any pilot to lose his way.

Yet this is only a start, and the day may not be far distant when radio, radar and television equipment replace human pilots completely, so that aircraft take-off, fly and land under automatic control. When that day comes, air accidents will be almost things of the past.

Chapter Sixteen

FRONTIER OF SPACE

IN THIS BOOK we have caught glimpses of how all sorts of pilots in all shapes and sizes of aeroplanes are working to make life better, easier and happier for the whole world. We have seen a 64-year-old retired U.S. naval officer helping to keep our forests alive by fighting insects from a crop-spraying biplane; young French lads following in the steps of the great pioneers of flying by teaching themselves to fly on home-made light planes; and blue uniformed British airline captains, young in years but old in experience, maintaining our proud seafaring traditions in the air ocean.

But there is another small band of pilots whose daily routine involves more danger than crop spraying, more adventure than conquering the air in a home-made aeroplane, and more responsibility even than flying a plane-load of men and women over oceans and mountains in all weathers, to every corner of the world.

Let us watch one of them at work. His name is Bill Bridgeman and he is a test pilot with the great American Douglas Company. The date is in August, 1951; the scene 30,000 ft above the scorched wastes of the Californian desert.

Bridgeman is sitting in the cramped cockpit of a bullet-shaped research plane named the Skyrocket, which is clasped in the cutaway bomb bay of a Superfortress 'mother-plane'. The Japs carried their suicide bombers into action in the same way during the war in the Pacific; and there are many pilots who see little more future in the sort of flying that Bridgeman does.

Suddenly, he pushes a button; the Skyrocket's tremendously powerful rocket engine roars into life; and it drops away from the Superfortress like a huge, super-streamlined winged bomb. Within seconds it is streaking upwards, faster and faster, leaving the mother-plane far below it. The sky turns from blue to purple and then black. There is slight shuddering as the Skyrocket crashes through the once dreaded sound barrier, and still the speed mounts to 800 . . . 900 . . . 1,000 . . . 1,100 . . . 1,200 m.p.h. and beyond. Impossible to control in the thin air at 79,000 ft, it begins to spin around in a vicious roll . . .

Now let us skip a year or so, and watch Bill Bridgeman make the first flight of a still more fantastic aeroplane—the Douglas X-3. It is longer and heavier than a fully loaded Dakota air liner, yet its wings span only 22 ft 8 ins—less than a Dakota's tailplane. As it streaks along, the pilot of an escorting Sabre hears Bridgeman shout over the radio that the X-3 does not seem to want to stay in the air. Its tiny wings give barely enough lift to keep it there; and the Sabre pilot begins to sweat at the thought of trying to land the X-3 at around 200 m.p.h. He has good cause, for the forward view from its cockpit is so restricted that he must act as Bridgeman's eyes, guiding him by radio during the entire landing approach and touch-down.

Just one more quick visit to those same skies over the

U.S.A.F.'s secret Edwards Air Force Base, deep in the Californian desert. The date 12th December, 1953. This time the pilot is Major Charles Yeager, who, in October, 1947, became the first man ever to fly faster than sound. He has just been dropped from a mother-plane, like Bridgeman, and his Bell X-1A research aircraft is streaking to 70,000 ft, flying faster than anyone has ever travelled before—1,650 m.p.h., more than 2½ times the speed of sound.

He cuts its motor and it immediately goes out of control, slamming Yeager so hard against the cockpit hood that the inner layer of perspex cracks. Down tumbles the X-1A for mile after mile, with Yeager 'blacked out', slumped over its controls . . .

Three stories; all of them reading like something out of science fiction, yet all true. Bridgeman and Yeager recovered control of their aircraft, landed safely, and later flew again in the same aeroplanes. But other pilots have been less lucky. 'Skip' Ziegler fell to his death when the X-2's fuel exploded, throwing it from the bomb bay of its mother-plane. In England Geoffrey de Havilland died when his little D.H.108 tailless research plane broke up under the pounding of shock waves formed as it approached the threshold of the sound barrier.

Yet men like these must go on facing death day after day in the skies over America, Britain, France, and Russia, or there would be no more progress. The back-room boys can cover hundreds of sheets of paper with involved calculations; the aerodynamicists may show by testing models in high speed wind tunnels that a new design ought to be capable of faster than sound flight. But the only way to prove its performance is by

building the full-size aeroplane and flying it through the sound barrier. And only the finest test pilots can do that.

The aircraft they test today are the shapes of tomorrow. Already they have found that sweptback wings—so necessary for the fighters of today, which fly at around the speed of sound—will not be needed on the still faster aircraft of the future. Instead, there will be a return to small, tremendously strong 'straight' wings like those of the X-1A, or delta wings like the British Fairey Delta 2, fastest jet plane in the world.

Straight wings will be ideal for small, fast fighter planes, and they are easy to build. But when heavy loads of bombs, guns, passengers or freight have to be carried, the delta wing is often best, because it combines great lift with short span and has a vast amount of room inside it for engines, fuel, undercarriage and payload.

But research planes are not testing only wing shapes. The thin air through which they fly may have a temperature of minus 67 degrees Fahrenheit, yet the friction of this air over their metal skin may heat them to more than 250 degrees. To enable pilot and plane to survive, they have to be refrigerated; and the same sort of refrigeration systems will be useful for the ultra-fast warplanes and air liners of the future.

They are proving the practicability of new power plants; testing the functioning of equipment at heights and speeds never before achieved by man. They are seeking out the limitations of both men and machines not only so that the next generation of aircraft may be faster and safer, but as a first step in the greatest adventure still left to man—space flight.

When Bill Bridgeman climbed to a height of 79,000 feet in the Skyrocket, he had about 95 per cent of our atmosphere below him. Since then, Major Arthur Murray has flown still higher in the X-1A. The suits they wore and the pressurised cockpits in which they travelled would have been equally suitable for flight in the vast emptiness of space.

Pilotless guided missiles and rockets too are approaching the space frontier. Already American and Russian rockets have reached heights of 240 miles. Photographs of Earth have been taken from great heights. The effect of cosmic rays has been measured many times at over 100 miles. Mice and monkeys have been carried up 40 miles and brought down safely inside little pressurised cabins by parachute.

Almost incredible radio and radar guidance systems are being invented for guided missiles, including one device that keeps a missile on its precise course by day or night by automatically observing certain stars.

All these things will play their part when the time comes for building the first moon rocket. Meanwhile, the whole operation has been planned down to the minutest detail. All we need is a new engine or fuel of tremendous power and tens of millions of pounds to pay for it all. Given those, space flight will no longer be a matter of science fiction or dreams.

To escape the pull of Earth's gravity and travel to the moon, a rocket will have to reach a speed of 25,000 m.p.h.; and the fastest rocket yet built flew at only 5,000 m.p.h. Yet there is hope even with today's fuels, if we are prepared to pay for and build a big enough rocket.

We can see why if we take a look at the American

'bumper' rocket that reached a height of 242 miles. It consisted actually of two rockets—a big German V.2 carrying a much smaller 'WAC Corporal' on its nose. Neither rocket by itself could have achieved sufficient speed to reach 240 miles: but as a team they made it possible. They took off under the 28 ton thrust of the V.2's great engine. Then, when the V.2's fuel was all burned up, it dropped away, the motor of the 'WAC Corporal' started firing and it travelled on alone. The important thing was that at the moment of separation it was travelling at several thousand m.p.h., and *its own speed was added to this.*

So, if we built a very large rocket, carrying a smaller one on its nose and a still smaller one on top of that, each capable of producing a speed of 6,000 mph, by the time the first two 'stages' had used their fuel and dropped away and the final, small rocket had reached its maximum speed, it would be travelling at nearly 3 x 6,000 m.p.h., or 18,000 mph.

At this speed, if it were made to flatten out at a height of around 500 miles, it would go on circling round the Earth continuously like an artificial moon, even after its fuel was all burned up, because there would be virtually no atmosphere to slow it down. Its speed would be about 16,750 m.p.h. by the time it settled down in its orbit; and the centrifugal force trying to fling the rocket out into space at this speed would exactly balance the force of gravity trying to pull it back to Earth.

It would be very useful, because as it whizzed around, it could radio back automatically data on such things as cosmic rays. It might even contain a television camera that would bring us an exciting aerial view of the

mountains, rivers, towns and oceans of Earth as it passed overhead.

More important still, it could carry up a load of rocket fuel instead of scientific instruments. Then, in due course, the first piloted rocket could be fired up in the same way to the 500 mile orbit around the Earth, use radar to find the pilotless rocket, tie up alongside and transfer the fuel to its own tanks. This sounds a pretty tricky business, but rocket experts claim that it would be no more difficult than refuelling a jet fighter in mid-air from a flying tanker with present day flight refuelling methods.

So, we should then have a piloted rocket with full fuel tanks, travelling around the Earth at 16,750 m.p.h. 500 miles above our heads. Remembering that the Moon is 239,000 miles away this does not seem very far along the road through space. But in terms of fuel and speed, it would be well over half way, because at that height the rocket would need to increase its speed by only a further 6,750 m.p.h. to escape the pull of gravity and complete the journey to the Moon. This does not seem impossible even today.

It is difficult to give an idea of when it may all come about. If some of the hundreds of millions of pounds being spent on guided missiles and rockets all over the world were diverted to space flight experiment, it would certainly be a great deal sooner, and the first pilotless 'artificial Moon' rockets—or, to give them their proper name, earth satellites—could be sent up into a 500 mile orbit within seven to ten years. At the same time, the first pilotless rocket could probably be fired into the Moon.

Soon afterwards, pilotless rockets could be made to encircle the Moon, sending back radioed data and even

television pictures of the surface. The first piloted rocket would follow and, at last, man would set foot on another world for the first time.

When? It could be within 20 years, it should certainly be within 50 years, and that will be only a start, for there is a whole Universe waiting to be explored.

Meanwhile, back on Earth, flying will be very different from what we know today. Vast aerodromes with long concrete runways may be things of the past, for many aircraft will take off vertically, like helicopters. But they will behave more like the fantastic Rolls-Royce 'flying bedstead' research machine than helicopters, for—except for helicopter air buses—they will use jet and rocket power, not rotating wings, to raise them from the ground.

It is possible that they will be powered by swivelling jets, pointing downwards during take-off, to thrust them off the ground, and turning through 90 degrees to thrust them forward in cruising flight. But, far more likely (and more secret at the moment!) their jet engines may be arranged so that they suck air over the aircraft's wings. This will produce lift in exactly the same way as if the wing were moving forward through still air, which is what happens when a present-day aeroplane takes off, and the machine will rise vertically.

Short-range two or four seat aircraft could be quite simple affairs with swivelling jets: but the giant long-range air liners of the future will probably be delta shaped vertical take-off flying wings powered by atomic engines, which would enable them to fly around the world at about 1,500 m.p.h. on a pound of fuel.

Fantastic? Perhaps. But the Wright brothers in 1903 would have thought it equally fantastic that within 50

years man would be able to fly at 1,650 m.p.h., cross the Atlantic in less than 3½ hours and sit in an armchair watching moving pictures produced out of thin air by 'Stratovision'. Who knows what new wonders aviation will make possible in its second half century?